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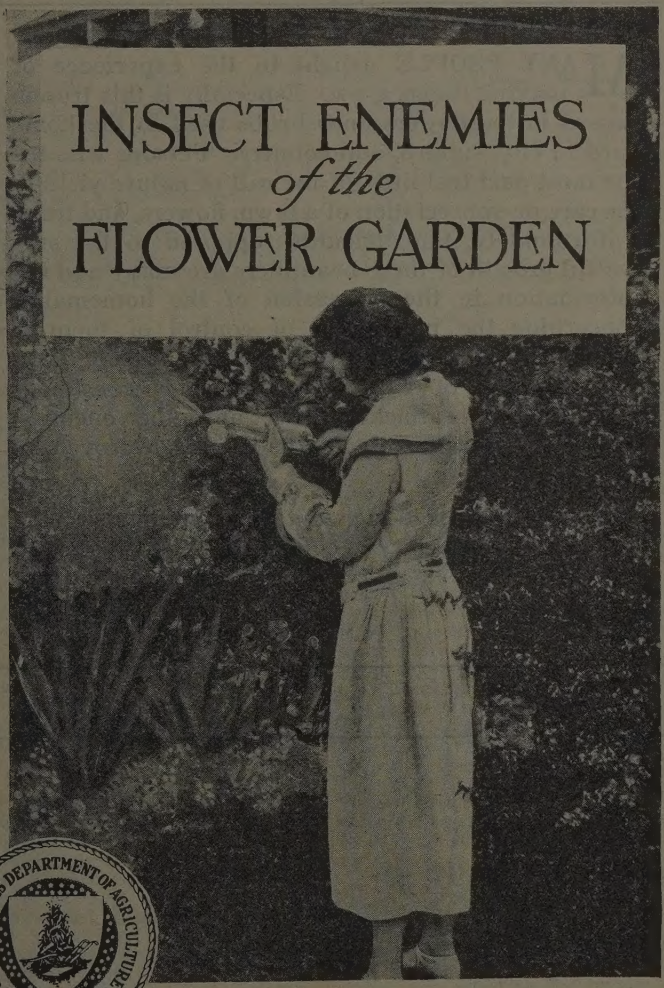
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1495

INSECT ENEMIES *of the* FLOWER GARDEN



given below, should be used. The arsenical insecticides are stronger, more certain, and generally to be preferred; but the material should be chosen with proper consideration for the sensitiveness of the plant, the character, extent, and seriousness of the injury, and other local conditions. These insecticides are obtainable at seed and insecticide stores and should be used either in solution or as a dust, according to the directions herein given or as prescribed on the container by the manufacturer.

ARSENATE OF LEAD SPRAY

1 pound of powder to 50 gallons water; or, in small quantities,
3 teaspoonfuls of powder to 1 gallon of water.

For many plants, particularly those having glossy, waxy, or smooth leaves, the addition of about 1 ounce of soap to every gallon of water used in the spray solution will aid materially in spreading the insecticide and making it adhere.

Although 1 pound of powdered arsenate of lead to 50 gallons of water is the recommended dosage, this may be increased to the rate of 2 pounds of powder to 50 gallons of water for more resistant plants and larger or older caterpillars. However, it should be borne in mind that delicate and especially brightly colored flowers and tender foliage are subject to injury by such sprays.

One drawback to the use of arsenate of lead is its tendency to leave a whitish residue on the sprayed leaves. This, however, should not be stressed as a decided objection, since spraying is recommended only when the plants are seriously affected or threatened, and the material must then be applied promptly to the parts attacked. Following an effective treatment and the disappearance of the defoliators, the new leaves which appear with the growth of the plants will show neither spray residue nor insect injury.

A satisfactory spray combining the properties of the stomach poison and the contact insecticide may be made by preparing the arsenate of lead solution as directed above and adding one-half ounce of soap and 1 teaspoonful of nicotine sulphate to each gallon of the lead arsenate solution.

In mixing the arsenate of lead a gallon of fungicide such as Bordeaux mixture may be substituted for the gallon of water.

A dust prepared as follows is very useful in controlling many leaf-feeding insects and is easy to mix and apply.

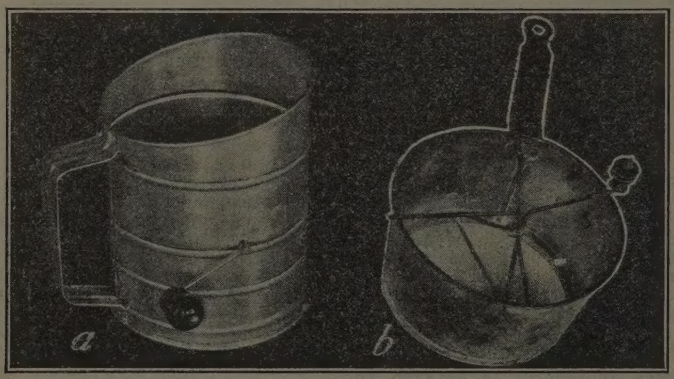


FIG. 1.—Flour sifters used in mixing nicotine dust

ARSENATE OF LEAD DUST

1 ounce, or part, powdered arsenate of lead.
4½ ounces, or parts, hydrated or air-slaked lime.
4 ounces, or parts, superfine sulphur.

The ingredients are first thoroughly mixed and then sifted several times through a fine-mesh screen or ordinary flour sifter. (Fig. 1.) To apply this dust use any of the hand dusters or blower guns available on the market or place the dust in a cheesecloth sack and jar or shake it over the infested plants.

By adding one-half ounce of 40 per cent liquid nicotine sulphate to the dust at the time of mixing it acquires valuable contact insecticidal properties. (See "Contact insecticides.")

PARIS GREEN

Paris green, at the rate of 1 teaspoonful to 3 gallons of water, may also be used, but since it has a tendency to burn foliage and flowers 2 or 3 ounces of lump lime should be added to minimize the burning. Paris green finds more general use in poisoned baits. (See p. 21.)

HELLEBORE

Hellebore, if fresh, is useful in combating some caterpillars and other insect enemies of this type, especially when they are young. It may be applied as a spray material, at the rate of 1 ounce in 1 gallon of water, or as a dust, when 1 ounce is mixed with from 5 to 10 ounces of air-slaked lime or flour.

CONTACT INSECTICIDES

The sucking insects, which include thrips, aphids, scale insects, and mealybugs, are not affected by stomach poisons because they draw their food from within the plant; they must therefore be combated with contact insecticides which kill by their burning action, by poisoning through the breathing apparatus, or by suffocation.

In the application of the contact sprays the essential point is so to treat the plants that the insecticide comes into direct contact with the body of the pest. Thorough and forcible spraying from a number of angles is especially important in order that all insects on the undersides of leaves and other protected parts of the plants may be reached.

NICOTINE OR TOBACCO SOLUTION

Of the standard contact sprays nicotine or tobacco extract is most generally used because of its effectiveness and the ease with which it may be prepared. It can be purchased as a liquid containing free nicotine or nicotine sulphate under a number of proprietary names. These concentrates usually contain not less than 40 per cent of nicotine and when of this strength should be diluted with water as follows:

Small quantities	1 to 1¼ teaspoonfuls to 1 gallon water.
Larger quantities	1 fluid ounce to 8 gallons water.

This solution is to be prepared by dissolving an ounce of common laundry or fish-oil soap in each gallon of water and adding the nicotine sulphate solution immediately before spraying.

NICOTINE DUSTS [1]

Nicotine dusts containing 5 per cent of nicotine sulphate solution of 40 per cent nicotine content (approximately 2 per cent of nicotine) have given good results in controlling plant lice, or aphids, and similar flower-garden insects. Hydrated lime, or a mixture of hydrated lime and finely ground sulphur, are useful as carriers of the nicotine. The dusts may be prepared

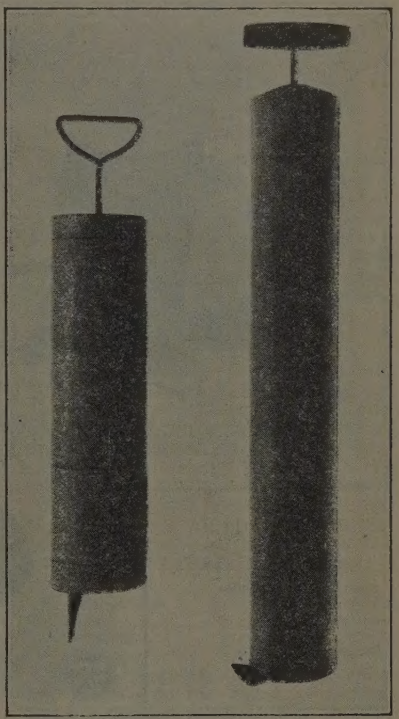


FIG. 2.—Two types of small hand dusters suitable for backyard gardens. (Campbell)

by mixing nicotine sulphate solution (containing 40 per cent of nicotine) with the dust carriers in the following proportions:

Formula No. 1

	5-pound lots	10-ounce lots
Nicotine sulphate	¼ pound.	½ ounce.
Hydrated lime	4¾ pounds.	9½ ounces.

Formula No. 2

Nicotine sulphate	¼ pound.	½ ounce.
Hydrated lime	2¼ pounds.	4½ ounces.
Finely-ground sulphur	2½ pounds.	5 ounces.

[1] See also CAMPBELL, R. E. NICOTINE DUST FOR CONTROL OF TRUCK-CROP INSECTS. U. S. Dept. Agr., Farmers' Bul. 1282, 24 pp., illus. 1922.

The nicotine-sulphate solution must be thoroughly mixed with the dust carrier, and the dust should either be used promptly or stored in an air-tight glass or metal container, to avoid loss of nicotine by evaporation. To prepare small quantities of this dust first mix the dry ingredients carefully, then slowly sprinkle the required quantity of nicotine-sulphate solution over the dust, and mix thoroughly. Then sift the dust through a flour sieve (fig. 1) about three times in order to obtain an even distribution of nicotine through the dust. The small lumps that may appear on the sieve screen, especially in the first sifting, should be crushed through the screen.

The dust can be applied by means of commercial hand dusters or blowers (figs. 2 and 3), several types of which are on the market.

Dusting should be done preferably when the temperature is above 65° F., the plant foliage dry, and the air still. Thoroughness of application to all infested portions of the plants is a very important factor in control. In case of heavy infestations it may be necessary to repeat the treatment to obtain complete control.

In mixing and applying the dust the operator should be careful to avoid inhaling much of it, for it may cause considerable irritation in nose and throat.

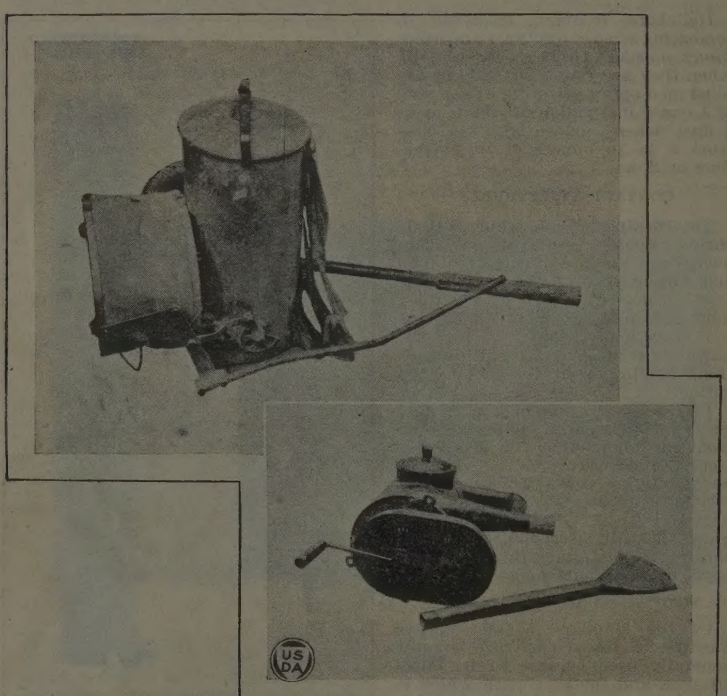


FIG. 3.—Hand dusters for applying dust mixtures in large gardens or commercial plantings. Upper, bellows type; lower, fan type. (Weigel and Sasscer)

By adding one-half pound of arsenate of lead to the 5-pound lots and one ounce to the 10-ounce lots of nicotine dust described above, a combined stomach and contact insecticide dust is obtained which is useful against both leaf-feeding and sucking insects.

NICOTINE OLEATE

A stock solution of nicotine oleate is prepared by mixing 10 parts of 40 per cent volatile or "free" nicotine solution with 7 parts of oleic acid or red oil. This combination results in

a product similar to soft soap. It is then diluted with equal parts of rain or soft water. For spraying, the stock solution as thus prepared is further diluted as follows:

4 tablespoonfuls stock solution to 1 gallon water (for 1-to-500 strength).
2 tablespoonfuls stock solution to 1 gallon water (for 1-to-1,000 strength).

H. F. Dietz in a recent publication[2] states that florists are obtaining a good control of white flies and red spiders by spraying with a commercial preparation of nicotine oleate, using 1 fluid ounce of the stock solution to 2 gallons of water.

This new contact insecticide has been developed within the last few years.[3] It may be prepared from any nicotine preparation containing "free" nicotine. It dissolves in soft water, forming a soapy solution which may be used to emulsify an animal, vegetable, or mineral oil, especially kerosene.

SOAP SOLUTION

For such insects as aphids, thrips, the crawlers of scale insects, and red spiders, an ordinary soap solution may be employed successfully. This solution is prepared by dissolving 1 pound of either fish-oil or laundry soap in from 2 to 4 gallons of hot water. Preferably, it should be applied while still lukewarm, especially if the stronger concentration is used.

PYRETHRUM POWDER

Pyrethrum powder is a contact insecticide which is useful for repelling ants and aphids. It is also very effective against the Florida fern caterpillar, certain slugs, and other leaf feeders. A solution of pyrethrum for use as a spray may be prepared by steeping 1 ounce in a small quantity of water for 10 to 15 minutes, and then adding enough water to make a gallon.

SULPHUR MIXED WITH WATER

Sulphur mixed with water at the rate of 1 ounce to 1 gallon and sprayed on infested plants is a good remedy for the red spider. One or two ounces of soap per gallon of this mixture may be added to increase its efficiency.

Since sulphur does not mix readily with water, a "wettable" sulphur is obtained by mixing equal parts of sulphur and hydrated lime and then stirring in just enough sweet milk to wet them. In this mixture the soap should be omitted.

DRY SULPHUR

Dry sulphur is often used as a dust and serves both as an insecticide and fungicide.

DRY LIME-SULPHUR

Dry lime-sulphur (commercial) in the proportion of 1 ounce to 3 gallons of water is another good remedy, especially for the red spider when present on very tender foliage, and it also possesses a fungicidal value. As a dormant or winter spray 1 pound to 2 gallons of water should be used.

COMMERCIAL LIME-SULPHUR CONCENTRATES

Commercial lime-sulphur concentrates (liquid) are very effective against scale insects and mites, especially when applied as dormant sprays. They may be purchased at seed stores and should have a density of about 33° on the Baumé scale. For dormant or winter sprays use 1 pint of the concentrate to 1 gallon of water.

KEROSENE EMULSION

Kerosene emulsion is one of the most effective of contact insecticides but should not be used on the more succulent plants such as coleus, heliotrope, and begonia. A 5 per cent solution controls immature scales and red spiders, and a 1 per cent solution is effective against aphids, ants, and thrips. A stock emulsion may be prepared from kerosene, fish-oil soap, and water in the following proportions:

Stock emulsion	Small quantities	Large quantities
Kerosene	2 pints.	2 gallons.
Fish-oil soap	1 ounce.	½ pound.
Water	1 pint.	1 gallon.

Cut the soap into chips or shavings and dissolve in the water by boiling. Remove the hot solution from the fire and add the kerosene very slowly, stirring constantly. It is important to have the solution hot as well as to agitate it thoroughly while adding the kerosene. After all the kerosene has been added pump the emulsion through the nozzle back into a suitable container for several minutes. Small quantities may be emulsified by beating or whipping with a paddle. This will give a creamy emulsion, which may be kept tightly bottled until ready for use.

[2] DIETZ, HARRY F. GREENHOUSE INSPECTION IN INDIANA. Ind. Dept. of Conservation, Rept. of Div. of Ent. and List of Nurserymen for 1921, pp. 8–15. 1922.
[3] MOORE, WILLIAM. A PROMISING NEW CONTACT INSECTICIDE. In Jour. of Econ. Ent., June, 1918, vol. 11, No. 3, pp. 341, 342.

The kerosene stock emulsion contains 66⅔ per cent of kerosene and must be diluted with water before using. The following table gives the proper dilution for sprays of different kerosene content.

Stock emulsion	Water	Kerosene oil content
1 part[4]	65⅔ parts.	1 per cent.
1 part	32⅓ parts.	2 per cent.
1 part	12⅓ parts.	5 per cent.
1 part	5⅔ parts.	10 per cent.

Kerosene emulsion should be applied preferably in the late afternoon, and the plants should be thoroughly syringed with water on the morning following. Soil overrun with ants may be freed entirely of these pests without serious injury to any of the plants by using a 5 per cent emulsion.

LUBRICATING-OIL EMULSION

Lubricating-oil emulsion has recently been proved a very efficacious remedy for combating the San Jose scale. The stock emulsion may be purchased or prepared according to the following formula:

Red engine oil (or oil of similar grade)	1 quart.
Water	1 pint.
Potash fish-oil soap	4 ounces.

In a special report published in the Journal of Economic Entomology (vol. 18, pp. 410–413, 1925), the subcommittee on insecticides and appliances of the American Association of Economic Entomologists decided that for the best results for scale control "oils" must come within the following limits:

Viscosity—180 to 220 seconds at 100° F. (Saybolt)
Volatility—Less than 1 per cent.
Specific gravity—0.88 to 0.91 at 20° C.

The oil, water, and soap are placed in a kettle or other receptacle and heated until the contents come to a boil. A brown scum appears on the surface of the mixture as it begins to boil. After boiling for a few minutes the scum begins to disappear, and at this stage the kettle should be removed from the fire and the entire mixture, while still very hot, passed through a force pump at least twice under not less than 60 pounds pressure. A proper emulsion can not be made by stirring, nor should the mixture be allowed to cool before it is pumped. The stock emulsion contains 66⅔ per cent of oil. For use add 1 part[5] to 33 parts of water for resistant plants, and 1 part to 50 parts of water for tender plants and growth.

MISCIBLE OILS

There are a number of proprietary "miscible" or "soluble" oils which are useful in combating scales and some other insects on hardy plants. These are obtainable at insecticide and seed stores under a variety of trade names, and should be used as directed by the manufacturers.

Miscible oils are primarily used as dormant sprays and are usually diluted at the rate of 1 gallon of the oil to 10 or 20 gallons of water. The oil should be well stirred before using, the tank and machinery free from alkalies, acids, and other impurities, the water must not be hard, and the oil should be poured into the tank and the diluting water added to it. As with other mineral-oil sprays, the liquid should not be allowed to puddle about the base of the plants.

CAUTION CONCERNING USE OF INSECTICIDES

Unfortunately these chemicals or insecticides are not only poisonous to the insects for the control of which they are recommended but also to human beings and other mammals. Therefore great care should be exercised in keeping, handling, and using insecticides and all possible precautions should be taken to prevent children and household or other animals from obtaining them.

Do not purchase quantities greatly in excess of your needs, and keep the packages well labeled and in a secure place. Mix the ingredients carefully. Avoid inhaling vapors or dust, conveying any of the materials to the mouth, or permitting them to come in contact with sores or injuries. Always wash the hands after handling or applying these chemicals. In treating plants, thoroughly coat the infested parts, but do not use so copiously that quantities of the material will coat the ground beneath. After spraying destroy or plainly label and securely store in a cool dry place any remaining material. Carefully clean and dry the spraying apparatus and destroy or properly dispose of any residue.

SPRAYING AND DUSTING EQUIPMENT

There are many types of spraying and dusting apparatus and accessories obtainable for use in the flower garden, each with desirable features and with sufficient range in price to place some form at the command of any

[4] Part by volume—liquid measure—ounce, pint, quart, etc.
[5] See footnote 4.

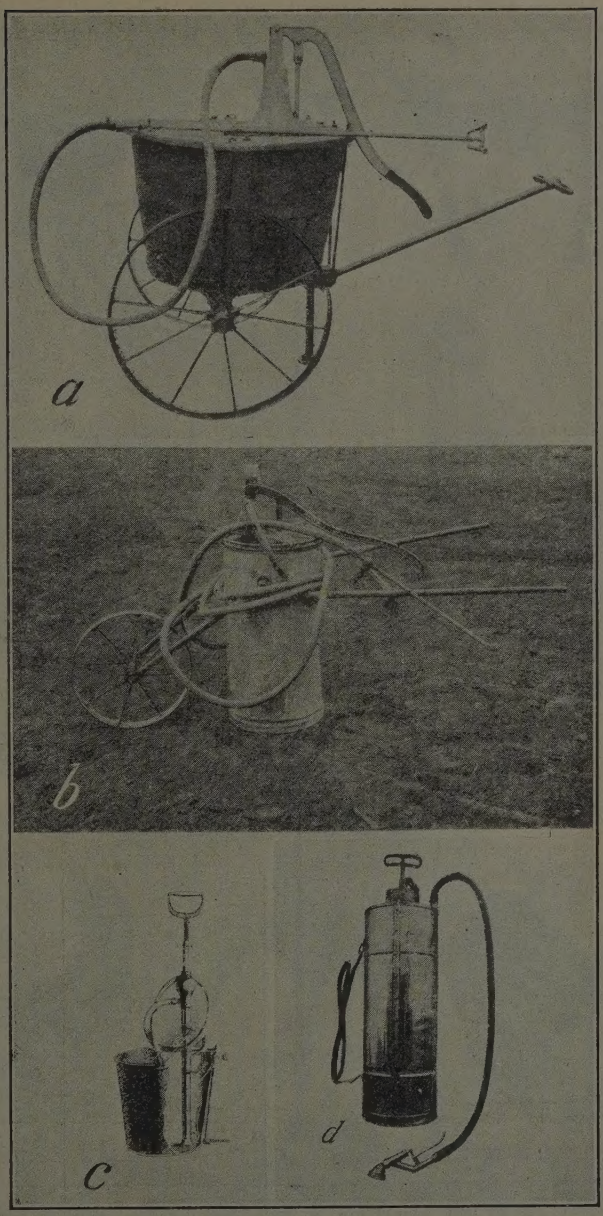


FIG. 4.—Hand-power sprayers for general use in gardens. A, two-wheel type (Weigel and Sasscer); B, one-wheel barrow type (Chittenden); C, bucket pump, suitable for spraying a few plants (Quaintance and Siegler); D, compressed-air type (Weigel and Sasscer)

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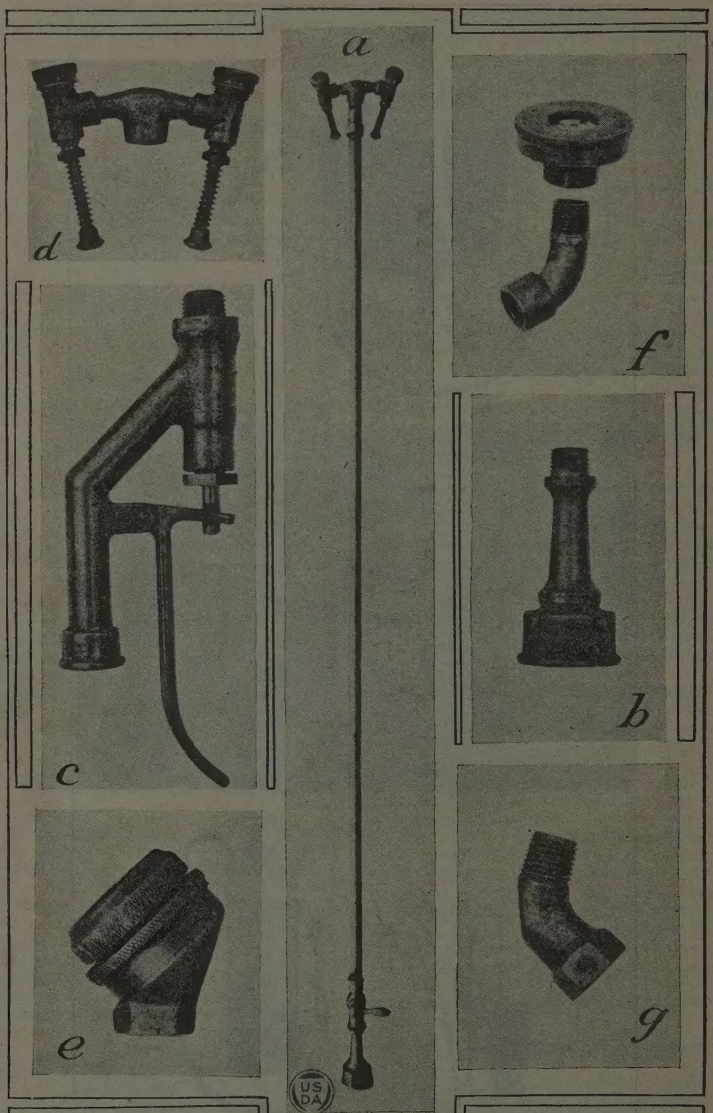


FIG. 5.—Spray nozzles and connections; *a*, Spray rod complete, showing female hose reducer, cut-off, brass spray rod, elbow, and cluster nozzles; *b*, female hose reducer; *c*, convenient type of control for end of spray hose; *d*, double spray nozzle; *e*, angled nozzle, whirlpool disk type; *f*, whirlpool type of disk nozzle and elbow; *g*, 45° elbow. (Weigel and Sasscer)

FIG. 6.—The cabbage looper

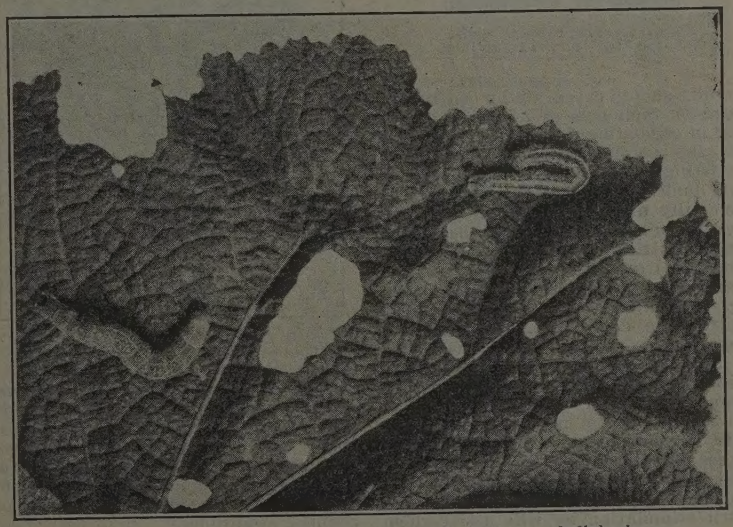


FIG. 7.—Caterpillar of the abutilon moth feeding on hollyhock

gardener. Figures 2 to 5 illustrate some of these. The apparatus selected for spraying should be so constructed as to break up the liquid into a fine mistlike spray and insure an even coating of the material over the plant surface.

COOPERATION AND GOOD CULTURAL METHODS ESSENTIAL

As a good general practice it is important that the gardeners of a community should cooperate by controlling pests on their own premises, by assisting in combating pests attacking other people's gardens, by encouraging and assisting those not yet converted to and understanding gardening, and by generally aiding and encouraging the development of good, clean, beautiful, and healthful surroundings. These principles are the very foundation of gardening and are of primary importance in preventing as well as in combating the depredations of injurious insects.

FIG. 8.—The cabbage worm feeding on nasturtium leaf

Then, too, there are certain preventive measures which are synonymous with good gardening, such as clean culture and proper fertilization. All flower gardens should be well cared for and kept free of weeds, and the plants should be furnished with the necessities for development and such stimulation as will assist them to maintain a vigorous and healthy growth.

Inasmuch as the same ground often is used year after year for the flower garden, the gardener should be careful to examine all seeds and plants before placing them in the soil. Exhausted and weak plants as well as weeds should be removed from the garden, and those diseased or infested by insects should be burned. The soil should be carefully examined, prepared, and enriched annually, preferably by turning under in the fall and spring. Such measures will do much to eliminate insects and disease and will result in vigorous and healthy plants. Moreover, strips of ground along the edges of the garden should be thoroughly cleaned each fall or spring and, if conditions warrant, burned to destroy any harbored plant pests, such as spider mites or plant bugs, especially under suburban or country conditions.

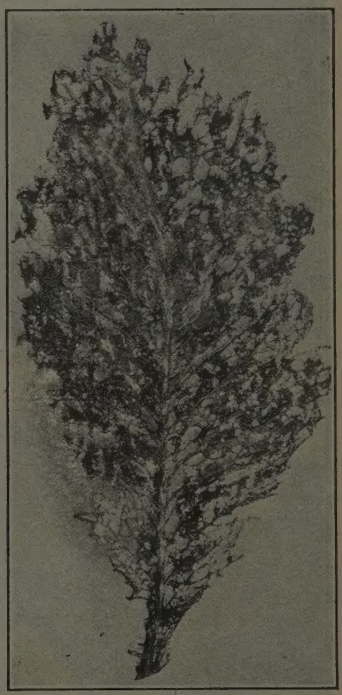


FIG. 9.—Leaf showing injury by the diamond-back moth caterpillar. (Jones)

Much can be done toward controlling insect pests of the flower garden by

frequently washing or syringing the infested plants with a stiff or forcible stream of water applied from a number of angles.

INSECTS THAT EAT PLANT TISSUE

Insects belonging to the plant-eating group, such as caterpillars and other wormlike forms, beetles, and grasshoppers, feed by biting or tearing, chewing, and swallowing portions of the foliage and flowers of the plant, and are responsible for the most obvious and frequently noted type of insect injury, that is, defoliation. Such injury, although frequently not a menace to the life of the plant, detracts from its beauty and vigor. The insects treated in the following section are the most common and the most generally encountered representatives of the species which devour plant tissue.

LEAF-EATING CATERPILLARS

THE CABBAGE LOOPER [6]

The cabbage looper (fig. 6) is the caterpillar of a medium-sized grayish-brown moth, deriving its common name from its preferred economic food plant and its habit of traveling from place to place by a curious looping or measuring movement of its body. The caterpillar is a delicate pale green when first hatched. When full-grown it is approximately 1⅜ inches in length, green, with a white stripe along each side of its body. Although this species is chiefly an enemy of cabbage, it is often found attacking such plants as chrysanthemum, carnation, mignonette, German ivy, geranium, and many others, including both greenhouse ornamentals and hardy shrubs.

Evidence of feeding work on leaves should be followed by a close examination of the infested plants, and the caterpillars will then be found.

Control by spraying or dusting with arsenate of lead.

THE ABUTILON MOTH [7]

The caterpillar of the abutilon moth resembles the cabbage looper in appearance and is not infrequently found in considerable numbers in the flower garden feeding on hollyhock (fig. 7), abutilon, and hibiscus.

Same control as for cabbage looper.

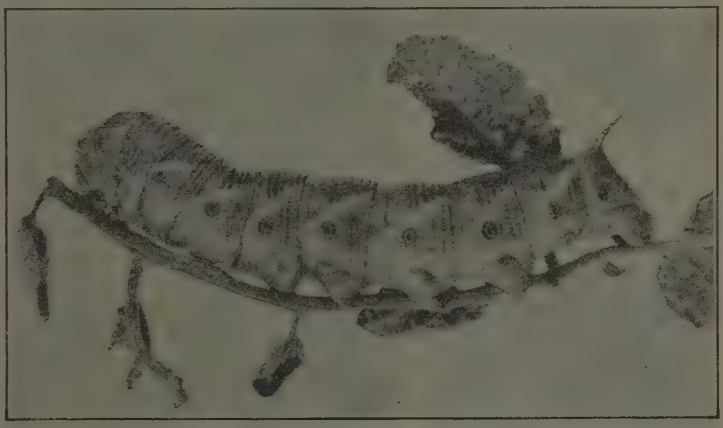


FIG. 10.—A hornworm, *Protoparce quinquemaculata*

THE CABBAGE WORM [8]

Another vegetable-garden pest, the cabbage worm (fig. 8), the adult of which is the ordinary white butterfly seen so frequently flying about on summer days, often leaves its preferred food plant and travels to the neighboring flower garden, where it feeds on nasturtium, mignonette, sweet alyssum, and several other ornamentals.

Same control as for cabbage looper.

THE DIAMOND-BACK MOTH [9]

The diamond-back moth, although primarily an enemy of cabbage, is often found attacking certain of the garden plants, such as sweet alyssum, stock, and wallflower. The caterpillars are slender, small, measuring

[6] *Autographa brassicae* Riley.
[7] *Anomis erosa* Hübn.
[8] *Pieris rapae* L.
[9] *Plutella maculipennis* Curt.

about two-fifths of an inch when full-grown, and are light green. They riddle the leaves with holes (fig. 9) and if abundant may completely defoliate them. The larvae are very active, wriggling away when disturbed and usually dropping and suspending themselves by a silken thread.

Besides spraying or dusting with arsenicals or pyrethrum, infestation by this pest may be warded off by clean culture and by preventing the growth of wild mustard and other weeds of the mustard family around the garden.

HORNWORMS [10]

Hornworms (fig. 10) are often found feeding on plants in flower gardens. They develop into the sphinx or hawk moths.

Spray or dust with arsenate of lead if a heavy infestation exists. Because of their size they can be easily collected and killed by crushing.

THE PAINTED LADY BUTTERFLY [11]

The caterpillar (fig. 11) of the painted lady butterfly feeds on the foliage of hollyhock and calendula. It also ties together the terminal leaves, giving to the plant an unsightly appearance.

Same control as for cabbage looper.

FIG. 11.—Caterpillar and work of the painted lady butterfly on hollyhock

THE PIPEVINE SWALLOWTAIL [12]

Caterpillars of the swallowtail butterfly feed on the leaves of the Dutchman's pipevine and are abundant in the Middle Atlantic States during the summer. The adult is an attractive, glossy, blue-green butterfly, which may be seen flashing about in the sunlight all through the summer around the veranda and other places where its

[10] *Sphinx eremitus* Hübn., *Celerio lineata* Fab., *Protoparce sexta* Johan.
[11] *Vanessa cardui* L.
[12] *Papilio philenor* L.

host plant is grown. A closely related species [13] (fig. 12) frequently feeds on and injures plants in the flower garden.

Same control as for hornworms.

THE ROSE BUDWORM [14]

The rose budworm, also called the "border swallow moth," attacks delphinium, rose, and columbine.

Spray or dust persistently with arsenate of lead.

THE CORN EARWORM [15]

The corn earworm, also called "the tomato fruitworm" and "the cotton bollworm," is another caterpillar better known for its ravages in the vegetable than in the flower garden (fig. 13). Nevertheless, it is a pest of annual and perennial flowers. The list of ornamentals subject to injury by the feeding of this species includes abutilon, ageratum, amaranth, canna, carnation, chrysanthemum, dahlia, geranium, gladiolus, hibiscus, mignonette, morning-glory, nasturtium, phlox, poppy, rose, and sweet pea. The corn earworm has at times become so abundant and injurious in its work as to destroy 30 to 50 per cent of the carnation and chrysanthemum buds in greenhouses. Geranium stems have been tunneled and great numbers of plants destroyed.

FIG. 12.—Larva of a swallowtail butterfly

Spray or dust with arsenate of lead.

WHITE-MARKED TUSSOCK MOTH [16]

The caterpillars of the tussock moth, besides being among the worst of the shade-tree pests, also feed upon the leaves of geranium, German ivy, and many deciduous ornamentals. The caterpillar is somewhat longer than an inch when full grown (fig. 14), has a red head, three long black plumes or pencils of hair at the ends of the body, and four yellowish brushlike tufts on the back somewhere near the head end. After feeding, the caterpillar constructs a cocoon of silk and hair for the resting stage. The male is a grayish winged moth; the female is whitish and wingless. The eggs are usually laid on the outside of or close to the cocoon (fig. 15) and are covered with a glistening white frothy material. Several generations generally occur during the year.

Thoroughly spray or dust all infested trees and plants throughout a community with arsenate of lead when the caterpillars are first observed. Cocoons and egg masses should be daubed with creosote oil or collected and destroyed by burning, a measure especially effective as a preventive if carried out in the late fall, winter, and early spring.

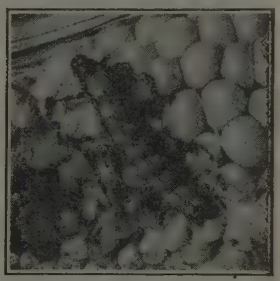


FIG. 13.—Larva of the corn earworm, which frequently attacks buds and foliage of ornamentals and flowering plants

THE YELLOW WOOLLY-BEAR CATERPILLAR [17]

The yellow woolly-bear caterpillar occurs throughout the United States. It is 2 inches long when fullgrown,

[13] *Papilio polyxenes* Fab.
[14] *Pyrrhia umbra* Hufn.
[15] *Heliothis obsoleta* Fab.
[16] *Hemerocampa leucostigma* S. & A.
[17] *Diacrisia virginica* Fab.

capped with many long hairs, which are usually pale yellow, brownish yellow, or fox red, and give to the caterpillar its characteristic color and appearance. The yellow bear is omnivorous, feeding upon the following: Dahlia, coleus, chrysanthemum (fig. 16), fuchsia, calla, hollyhock, sunflower, moonflower, morning-glory, petunia, salvia, verbena, and many other flowering plants.

FIG. 14.—White-marked tussock moth caterpillar. Enlarged. (Quaintance and Siegler)

The caterpillar is especially prevalent during July and August and overwinters in cocoons constructed from its woolly coat and silk, under loose shelters, such as trash, dead leaves, and clods of earth. Sometimes quantities of cocoons, even 20 or 30, are made under the same shelter. This feature may be utilized in controlling the caterpillar. The salt-marsh caterpillar[18] is also one of the woolly bears which may at times invade the flower garden and injure plants.

Destroy the chrysalids in cocoons found in sheltered places. Spray or dust with arsenate of lead if abundant.

[18] *Estigmene acraea* Dru.

THE STINGING ROSE CATERPILLAR[19]

This is one of several species of stinging caterpillars that have stiff hairs or spines which are somewhat poisonous and are capable of inflicting a painful burning sensation when they come in contact with tender skin. It is rather strikingly marked (fig. 17, *a*) with red, white, and violet stripes or lines and seven pairs of large spine-bearing processes. The adult insect is a moth which appears and lays its eggs in July. These hatch into the slug-like caterpillars which feed on rose leaves from the under sides and usually become full-grown some time in September. The species overwinters in a dark cocoon protected among leaves and other refuse on the ground.

FIG. 15.—Female white-marked tussock moth depositing egg mass on silken cocoon. Enlarged. (Quaintance and Siegler)

Spraying or dusting, particularly the undersides of the leaves, with arsenate of lead will kill the caterpillars, but where only a few are present hand picking is more advisable, care being taken to wear a glove as a protection against the stinging spines. Clean up refuse around plants in the fall and

[19] *Parasa indetermina* Bdv.

burn. Use clean straw if plants must be protected.

THE SADDLEBACK CATERPILLAR [20]

The saddleback caterpillar (fig. 17, *b*) is about an inch long, and brown at each end. The middle is green with a purple center, and resembles a small saddle. This caterpillar attacks rose and canna.

Same control as for the stinging rose caterpillar.

THE PUSS CATERPILLAR [21]

The puss caterpillar, which is broad, flat, and completely covered with long silken hairs (fig. 18), occasionally attacks roses and English ivy in the South.

Same control as for the stinging rose caterpillar.

WEBWORMS

Another group of caterpillars characterized by spinning web nests (figs. 19 and 20) are sometimes found invading and attacking plants in the flower garden, and of these the following are important. The fall webworm [22] feeds upon geranium, clematis, castor-bean, rose, honeysuckle, laurel, and wistaria, and the spotted beet webworm [23] on alternanthera. The morning-glory leafcutter [24] is recorded

FIG. 16.—The yellow woolly-bear caterpillar feeding on chrysanthemum

[20] *Sibine stimulea* Clem.
[21] *Megalopyge opercularis* S. & A.
[22] *Hyphantria cunea* Dru.
[23] *Hymenia perspectalis* Hübn.
[24] *Loxostege obliteralis* Walk.

as attacking Wandering Jew, morning-glory, violet, and zinnia, and the garden webworm [25] (fig. 21) feeds on castor-bean and scarlet verbena.

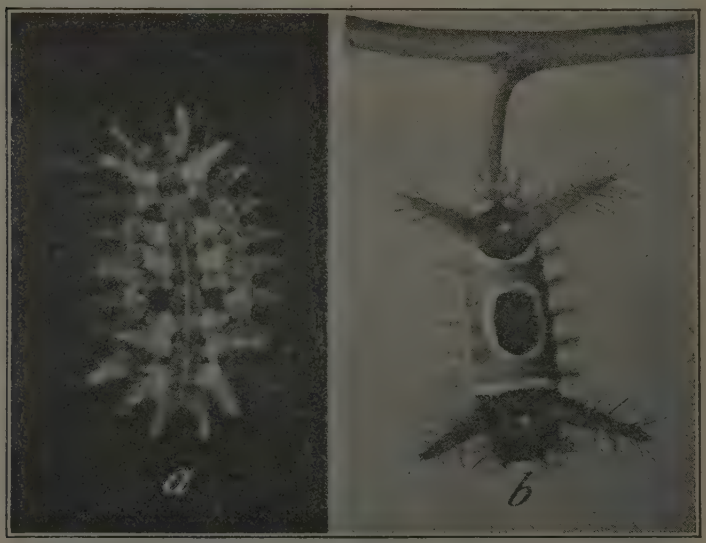


FIG. 17.—*a*, Stinging rose caterpillar; *b*, saddleback caterpillar

FIG. 18.—Full-grown puss caterpillar. (Bishopp)

Although arsenate of lead spray or dust will kill webworms, it is sometimes less trouble and equally effective to cut off infested webbed portions of plants and burn them. It is especially desirable to do this pruning early in the course of the infestation when only a few branches or leaves are involved. Burn out webs with a flame produced by burning newspaper or a kerosene-soaked rag wired to a pole. Crush any caterpillars falling to the ground.

[25] *Loxostege similalis* Guen.

THE LEAF ROLLERS

The work of a great many caterpillars, enemies of flowering plants, is characterized by a rolling, folding, and tying of the leaves fed upon. The common forms are described below.

The red-banded leaf roller [26] (fig. 22) is a small active caterpillar and is widely distributed in the United States, particularly in the East. It is a general feeder and occasionally attracts attention by its depredations on flowering plants. It attacks chrysanthemum, violet, rose, honeysuckle, geranium, zinnia, hollyhock, and lobelia. The full-grown larvæ are greenish and about three-fourths of an inch long. Several generations occur annually, depending on the weather and climate.

Spray or dust with arsenate of lead.

[26] *Eulia velutinana* Walk.

FIG. 19.—Nest or web of fall webworms on holly

The oblique-banded leaf roller, or rose leaf tyer,[27] ranges from yellowish to pale green in color and becomes about three-fourths of an inch long (fig. 23) when full grown. Two generations apparently occur annually, one brood of caterpillars rolling and feeding on the leaves in the late spring and the second brood in late summer. They eat the flower buds (fig. 24) and feed on aster, carnation, rose, geranium, honeysuckle, spirea, and verbena.

Same control as for red-banded leaf roller.

THE GREENHOUSE LEAF TYER[28]

The greenhouse leaf tyer, although chiefly a greenhouse pest, ties and skeletonizes the leaves of many flowering plants in gardens, among which are abutilon, canna, carnation, chrysanthemum, dahlia, geranium, heliotrope, violet, and sweet pea.

Same control as for red-banded leaf roller. Be sure to apply the dust or spray to the undersides of infested leaves.

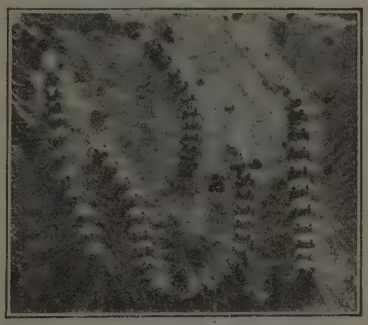


FIG. 20.—Fall webworm caterpillars. (Quaintance and Siegler)

CANNA LEAF ROLLERS

In the Southern States canna leaves are often attacked by two leaf rollers,

[27] *Cacoecia rosaceana* Harr.

[28] *Phlyctaenia rubigalis* Guen.

the lesser canna leaf roller [29] (fig. 25) and the larger canna leaf roller [30] (figs. 26 and 27). Both of these species are

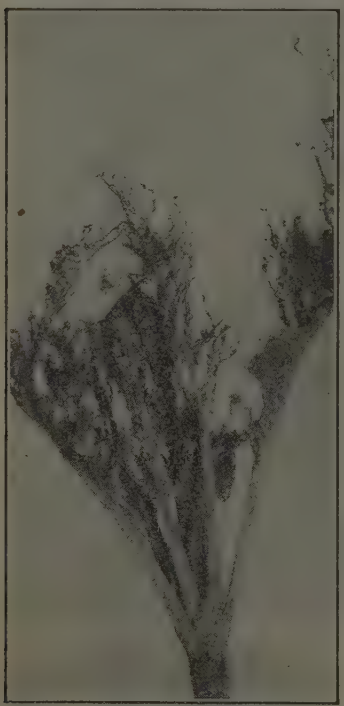


FIG. 21.—Feeding injury caused by the garden webworm

FIG. 22.—Red-banded leaf roller: *a*, Female moth; *b*, moth with wings folded at rest; *c*, larva, dorsal view; *d*, pupa, lateral view; *e*, tip of abdomen of pupa, showing abdominal hooks. *a–d*, About three times natural size; *e*, more enlarged. (Chittenden)

annoying in canna beds and evidences of their leaf rolling and feeding should receive prompt attention. Occasionally these species appear in the Northern States, but the severe winters seem to prevent their survival.

Spray or dust with arsenate of lead early in the season when the injury is first observed. Hand pick and destroy.

FIG. 23.—Larvæ of oblique-banded leaf roller. Enlarged. (Sanderson and Jackson)

THE ORANGE TORTRIX [31]

The orange tortrix is another pest of the flower garden in warmer climates and is a leaf roller which at-

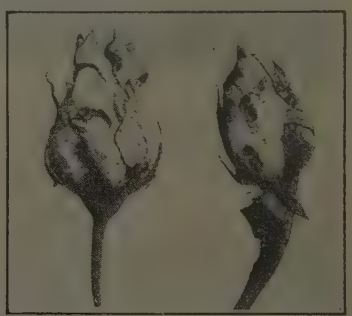


FIG. 24.—Rose buds injured by oblique-bandel leaf-roller caterpillars

tacks begonia, fern asparagus, ferns, Jerusalem cherry, geranium, rose, Wandering Jew, lantana, and lavender.

Same control as for red-banded leaf roller.

THE BAGWORM [32]

The bagworm is the caterpillar of a moth, the male of which has wings but the female is wingless and never leaves the bag (fig. 28) in which she

[29] *Geshna cannalis* Quaint.
[30] *Calpodes ethlius* Cramer.
[31] *Tortrix citrana* Fern.
[32] *Thyridopteryx ephemeraeformis* Haw.

lays her eggs. Deciduous and evergreen trees and shrubs are fed upon by this insect often to the extent of temporarily disfiguring them.

Pick and destroy the bags during the fall, winter, and early spring when they contain the eggs for next year's

FIG. 25.—Cannas injured by lesser canna leaf roller

generation. Also pick the bagworms or thoroughly spray or dust the infested plants with arsenate of lead during the summer.

CUTWORMS [33]

Many species of cutworms attack flowering plants, including dahlia, rose, zinnia, geranium, carnation, and aster. The plants are often severed at or near the ground when just starting (fig. 29) and sometimes when they are growing vigorously. Injuries of this kind are extremely annoying, and be-

FIG. 26.—Canna leaf, showing advanced injury by larvæ of the larger canna leaf roller. (Chittenden)

cause the plants are usually ruined overnight, or at least are fed upon to an extent that causes them to

[33] *Agrotis c-nigrum* L., the spotted cutworm; *Agrotis ypsilon* Rott., the greasy cutworm; and *Lycophotia margaritosa* Haw., the variegated cutworm, etc.

wither and die, destruction of those attacked usually is complete. The cut-

FIG. 27.—Full-grown larva of the larger canna leaf roller. (Chittenden)

FIG. 28.—Bagworm suspended from a twig

worms are smooth, plump, gray or brownish caterpillars which conceal themselves during the day under ground near the plants, and emerge toward evening to feed. They are very nearly omnivorous and feed on practically any of the flowering plants.

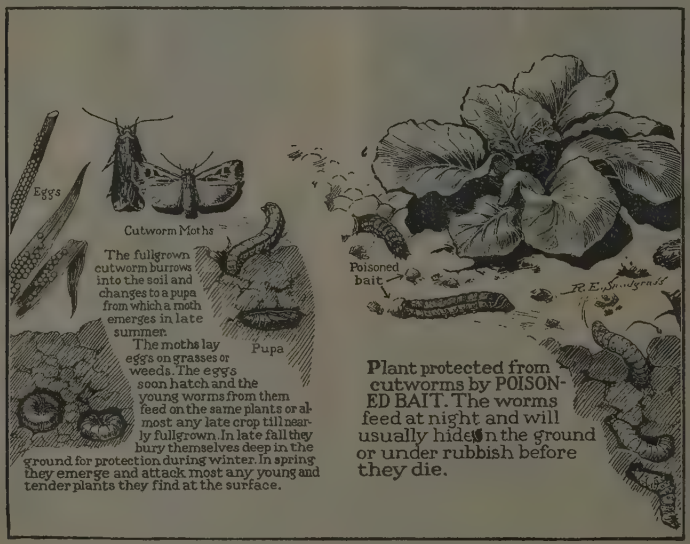

Eggs
Cutworm Moths
The fullgrown cutworm burrows into the soil and changes to a pupa from which a moth emerges in late summer.
Pupa
The moths lay eggs on grasses or weeds. The eggs soon hatch and the young worms from them feed on the same plants or almost any late crop till nearly fullgrown. In late fall they bury themselves deep in the ground for protection during winter. In spring they emerge and attack most any young and tender plants they find at the surface.
Poisoned bait
Plant protected from cutworms by POISONED BAIT. The worms feed at night and will usually hide in the ground or under rubbish before they die.

FIG. 29.—Various stages and injury of cutworms. (Snodgrass)

A poisoned bait such as follows, scattered about the infested area, is an effective control:

LARGE QUANTITIES

Paris green or white arsenic	4 ounces.
Bran (dry)	1 peck or 5 pounds.
Molasses or sirup	¾ to 1 pint.
Water	2 quarts.

SMALL QUANTITIES

Paris green or white arsenic	1 ounce.
Bran (dry)	1¼ pounds.
Molasses or sirup	3 ounces.
Water	½ pint.

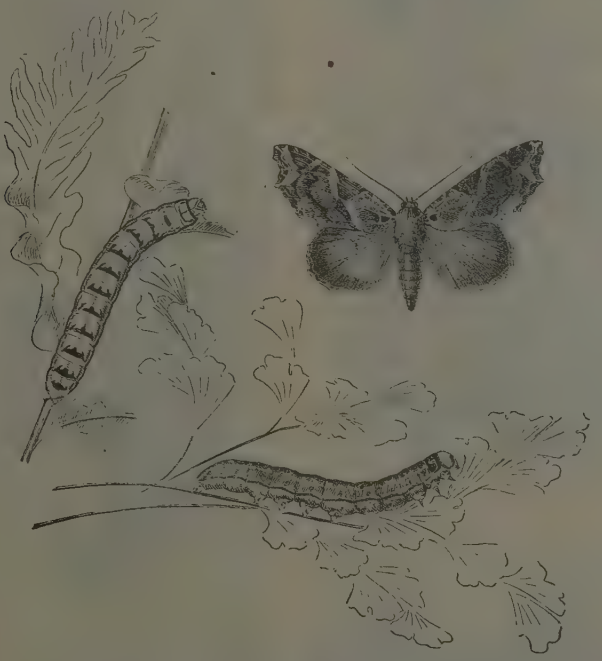


FIG. 30.—Florida fern caterpillar: Moth above; striped larva at left; dark larva at right. Enlarged. (Chittenden)

First mix the white arsenic or Paris green and dry bran thoroughly in a container. In another vessel stir a pint of cheap molasses or sirup into 4 to 6 quarts of water. Then prepare a mash by slowly adding the mixture of sirup and water to the poisoned bran. Allow it to stand for several hours to permit the bran to take up the arsenic. Scatter thinly over the surface of the soil along the rows of plants after sundown.

In combating these insects proper cultivation is of exceptional importance; the soil should be thoroughly broken up by plowing, disking, or spading in the fall and spring.

FLORIDA FERN CATERPILLAR [34]

In the Southern States a cutworm known as the Florida fern caterpillar often becomes a serious menace, especially in large ferneries. Two color phases of the caterpillar (fig. 30) are present when full grown, one a pale green and the other a velvety black.

Same control as for cutworms. Pyrethrum, either sprayed or dusted on, is also effective.

ARMY WORMS

In addition to the caterpillars already mentioned, some of the army worms frequently invade gardens.

Use the poisoned-bran mash recommended for cutworms, or spray or dust with arsenate of lead.

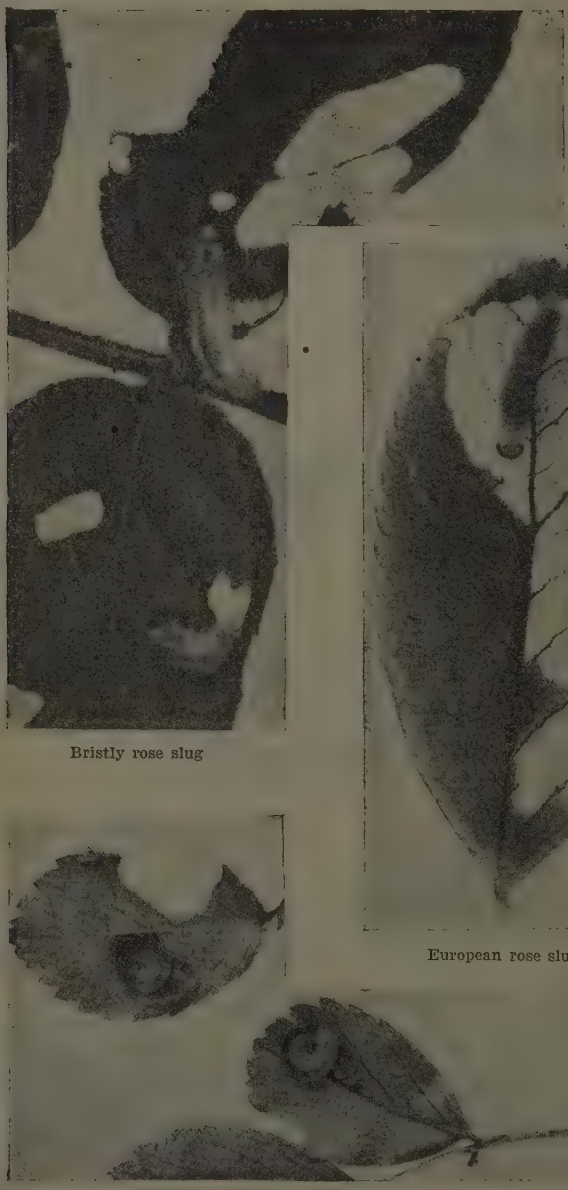
FALSE CATERPILLARS

THE BRISTLY ROSE SLUG [35]

The bristly rose slug when young skeletonizes the leaves from the under-

[34] *Callopistria floridensis* Guen.

[35] *Cladius isomerus* Nort.



Bristly rose slug

European rose slug

Coiled rose worm

FIG. 31.—Three injurious rose slugs. All more or less enlarged. (Middleton)

side (fig. 31) and when older eats the whole leaf tissue. Leaves skeletonized by this slug have a characteristic glazed appearance. This species has six generations a year in the neighborhood of Washington, D. C., and overwinters in cocoons in protected places such as rubbish. The cocoon is a thin transparent paper envelope which sometimes has a pale-brownish tint and may be of several thicknesses.

These larvæ may be controlled by spraying or dusting with arsenate of lead and also by a nicotine sulphate solution when young. Furthermore, frequent syringing or washing with a stream of water under pressure will kill the larvæ and prevent any considerable amount of injury. Cleaning up and burning all rubbish will remove many favorable overwintering places.

THE EUROPEAN ROSE SLUG[36]

The European rose slug skeletonizes the rose leaves from the upper side for its entire feeding period. Its work (fig. 31) produces a characteristic pale-greenish to yellowish chafed upper surface on the leaflets fed upon. This species has but one generation annually, overwintering in cells of cemented particles of sand and earth in the ground.

Same control as for the bristly rose slug.

THE COILED ROSE WORM[37]

The coiled rose worm eats the entire leaf tissue, usually feeding from a coiled position (fig. 31). This sawfly has two generations annually and spends its resting stage in cells bored in pith, soft decayed wood, or material of a similar texture. The coiled rose worm passes the winter in the resting stage protected within its cell.

Same control as for the bristly rose slug.

VIOLET SAWFLY[38]

The false caterpillars of this sawfly frequently are found feeding on the leaves (fig. 32) of violets and pansies in the eastern part of the United States and Canada. An examination of the soil or the lower leaves of the plants often reveals some bluish-black, smooth larvæ about one-half inch long, conspicuously marked with white tubercular spots on the back and sides. In the earlier stages the larvæ eat holes in the leaves, and later they may completely defoliate the plants. Feeding work may be found earlier, but it becomes most evident in late May and early June.

Spray or dust with arsenate of lead when the larvæ are first observed, but when only a few are present they may be hand picked.

THE RED-HEADED PINE SAWFLY[39]

Young and dwarf pines used for ornamental purposes about gardens are

FIG. 32.—Injury to violet leaves by the violet sawfly; *a*, Egg cells on upper surface of leaf; a_1, an egg cell magnified; *b*, cells after escape of larvæ; b_1, one of same magnified; *c*, egg from above; *d*, egg in situ from side; *e*, female at rest on leaf; *f*, newly hatched larvæ on leaf; f_1, same enlarged; *g*, active stage of larva; *h*, full-grown larva feeding. *a*, *b*, *e*, *f*, *g*, *h*, Natural size; a_1, b_1, *c*, *d*, f_1, enlarged. (Chittenden)

frequently fed upon by red-headed false caterpillars, which are white with black spots. These sawfly larvæ feed in clusters on the needles near or on the new growth (fig. 33) of the terminal or lateral branches of the pine. Sometimes they are present in such numbers as to strip a portion or even the whole of a tree. When this occurs the tree or the part affected is usually stunted or entirely killed.

Thoroughly spray or dust the infested pines with arsenate of lead.

[36] *Caliroa aethiops* Fab.
[37] *Emphytus cinctipes* Nort
[38] *Emphytus canadensis* Kby.
[39] *Neodiprion lecontei* Fitch.

Trees should be watched after the application of control measures to prevent a return of the infestation.

THE IMPORTED PINE SAWFLY [40]

In the northeastern section of the United States many young and dwarf

FIG. 33.—Terminal growth of pine showing larvæ of the red-headed pine sawfly and injury caused to foliage. (Middleton)

native and introduced species of ornamental pines grown on estates and in nurseries are being defoliated by the false caterpillars of the imported pine sawfly. These larvæ (fig. 34) are about an inch in length, greenish to blackish, with small yellow-spot markings when full-grown. They are nearly always found in clusters eating needles and, like the preceding species, disfigure and sometimes kill the trees attacked. They should be combated vigorously whenever discovered.

Follow the treatment recommended for the red-headed pine sawfly.

[40] *Diprion simile* Htg.

STALK, STEM, AND ROOT BORERS

Several species of caterpillars have the insidious habit of boring and tunneling through the stalks and stems

FIG. 34.—Larvæ of the imported pine sawfly feeding on pine needles. (Britton)

of fleshy and thick-stemmed plants such as dahlia, aster, zinnia, lily, hollyhock, peony, goldenglow, phlox, and delphinium.

THE STALK BORER [41]

The stalk borer is the chief offender in the flower garden. Before it is discovered its work usually progresses to the point where wilting and breaking over of the plant occur. A close examination of plants so affected will disclose a small round hole in the stem, which is the entrance to its burrow. Splitting the stalk lengthwise, one may find the culprit, a slender striped caterpillar (fig. 35), which when full-grown is an inch long. The parent moths occur in late summer and leave a pupal case in the burrows. They deposit eggs for the next season's brood on burdock and ragweed as well as on a variety of other plants.

There is no effective way of poisoning this caterpillar, as it is an internal feeder. The best remedy is clean cultivation and the burning of all stems, roots, and plant remains which are likely to harbor overwintering eggs. The growth of large weeds, especially the giant ragweed, should be prevented or they should be cut, raked together, and burned before the caterpillars contained within them can escape and migrate to garden plants near by. Removing the borers by slitting the stems lengthwise at the point of attack may be successfully employed. Cutting and crushing or burning the wilted tips is effective.

EUROPEAN CORN BORER [42]

In the areas of the New England States now infested with the European

FIG. 35.—*a*, Stem of goldenglow split to show the stalk borer; *b*, entrance hole to its burrow in hollyhock stem

corn borer, injury by this important pest is frequently reported. Dahlia seems to be the most susceptible of flower crops attacked, although aster, chrysanthemum, gladiolus, zinnia, cosmos (fig. 36) and hollyhock are also

[41] *Papaipema nitela* Guen.

[42] *Pyrausta nubilalis* Hübn.

fed upon. The corn borer (fig. 37) is easily distinguished from the common stalk borer by the absence of conspicuous bands or stripes characteristic of the latter, although the injury which it causes is similar. Moreover, the burrows of the stalk borer are larger than those of the corn borer.

Same control as for stalk borer.

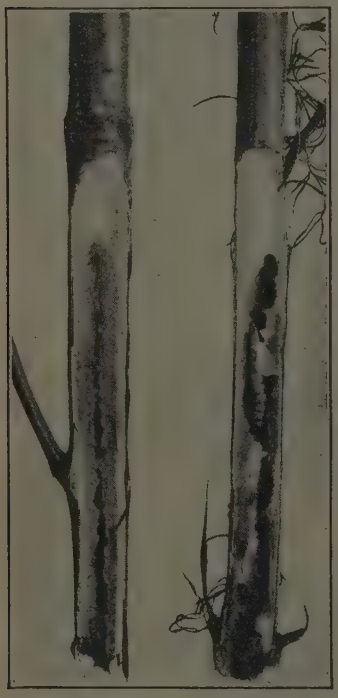


FIG. 36.—Cosmos stems cut to show European corn borer and injury

THE IRIS BORER [43]

The iris borer's principal injury is to the roots and crown (fig. 38) of iris, although decay and a blackening of the leaves of infested plants is a good indication of its presence. The full-grown larva is usually pinkish, with a brown head. It is about 2 inches long, with rows of black spots on the sides.

Winter burning of débris and weeds is the most effective remedy, since this destroys overwintering eggs and forestalls a reinfestation the following season. During the active growing season all plants should be carefully watched and when injury is observed the infested parts should be cut out and burned. New growth should be sprayed with arsenate of lead, soap, and nicotine-sulphate solution, and the spraying should be continued until at least the middle of May.

THE CLEMATIS ROOT BORER [44]

The clematis root borer attacks the roots and infests the crown of virgin's-bower (*Clematis virginiana* L.) and sometimes hollows out the bases of stems, causing the plants to show a lack of vigor and to become stunted. The borers, which are full grown by June or July, are then two-thirds of an inch long, dull white, with a brown head. They change to brown pupæ in a slight cocoon, and during the last days of July the adult moths emerge and soon thereafter lay their eggs.

The treatment recommended for the borers mentioned above should be used for this species also.

ROSE STEM BORERS

Occasionally roses are attacked by stem borers. These are of two kinds, those which attack unpruned and uninjured shoots and those which attack the pruned and broken ends of branches. Borers attacking the unpruned, uninjured shoots of rose are the rose stem

FIG. 37.—Larvæ of the European corn borer, slightly enlarged. (Caffrey and Worthley)

sawfly or borer [45] (fig. 39), the rose stem girdler,[46] and the raspberry cane borer.[47] The adult of the rose-stem sawfly is a wasplike insect and that of the raspberry cane borer is a beetle. Both fly in the early summer, and both lay their eggs in punctures made in the rose branches. The larvæ hatching from the eggs are whitish and mine

[43] *Macronoctua onusta* Grote.
[44] *Alcathoe caudata* Harr.
[45] *Adirus trimaculatus* Say.
[46] *Agrilus viridis* L.
[47] *Oberea bimaculata* Oliv.

within the shoots, causing them to die. The beetle of the rose stem girdler appears in June and July and lays its eggs on the rose bark. On hatching, the whitish larvæ enter the wood, make spiral mines for a short distance, and over these the rose shoot swells. The resting stage is spent in a cell in the pith.

Cut off and burn infested shoots as soon as they are observed.

THE LILAC BORER [48]

The lilac borer is the caterpillar of one of the clear-winged moths. It lays its eggs during the summer on caterpillars can be cut out individually or they may be killed by running a flexible wire into their burrows, or by injecting carbon disulphide therein. When carbon disulphide is used the openings of the burrows should be closed tightly for several days with some gas-proof material such as grafting wax. Afterwards the wounds should be opened, cleaned, and thickly coated with a waterproof preservative such as good lead paint.

THE RHODODENDRON BORER [49]

The rhododendron borer is related to the lilac borer, and is sufficiently like

FIG. 38.—Iris borer: *a*, Adult; *b*, larva; *c*, feeding work

roughened and wounded places on the bark, and the larvæ which hatch from them are pale yellowish white. The borers enter the wood (fig. 40) and there spend the winter. In the spring they become pupæ and in the early summer adults. The lilac borer is recorded as attacking mountain ash and the white, green, and English varieties of ash, as well as lilac.

Infested portions of bushes should be removed and burned during the late fall, winter, and early spring. The it in its feeding habits not to need a different or separate treatment.

THE DOGWOOD TWIG BORER [50]

The dogwood twig borer is a cylindrical beetle about one-half inch long. It girdles the twigs of dogwood and azalea, before depositing an egg under a slit in the bark, and causes the leaves to wither. The young larva burrows and feeds inside the stem (fig. 41). It winters as a full-grown

[48] *Podosesia syringae* Harr.
[49] *Aegeria rhododendri* Beutm.
[50] *Oberea tripunctata* Swed.

larva, pupating in May, and the adults are on the wing in August.

Cutting and burning infested twigs at any time, except in the summer, when the beetles are active, will control this species.

FIG. 39.—Young rose shoot cut showing rose stem borer mining in pith. Note the stunted tip resulting from its injury

BEETLES, WASPS, AND GRASSHOPPERS

THE ROSE BEETLE OR ROSE CHAFER[51]

The rose beetle or rose chafer is one of the outstanding insects that invade the flower garden, especially at the time when roses are in bloom. It is a long-legged, yellowish-brown beetle (fig. 42) about one-third of an inch in length. During June the beetles appear in swarms and do considerable damage. Their ravages usually last for about six weeks, and their disappearance is as sudden as their arrival. Although rose and grape seem to suffer most, the beetles feed on many other plants, including dahlia, peony, hollyhock, and hydrangea.

The rose beetle is one of the most difficult pests to combat. It is very active and such measures as can be

FIG. 40.—Work of the lilac borer

recommended do not insure that the adults killed will not be replaced by others. Furthermore, unless those killed die before they lay their eggs their death offers no promise of improvement in the situation during succeeding years.

Repeated applications of arsenate of lead, 1 pound to 10 gallons of either water or Bordeaux mixture, may be used on hardy ornamentals. It is also possible to protect choice plants with a covering of netting. Collecting and destroying the beetles on infested

[51] *Macrodactylus subspinosus* Fab.

plants is practical. Since the overwintering larvæ pupate in April and May, and since the pupæ are killed easily by disturbing the soil, thoroughly working all ground that may serve as breeding places during May or June, depending on locality, is recommended.

THE TWELVE-SPOTTED CUCUMBER BEETLE[52]

The 12-spotted cucumber beetle, another common vegetable garden pest, also feeds on the leaves (fig. 43), buds, and flowers of a considerable number of garden flowering plants, such as

FIG 41.—Larva of the dogwood twig borer in stem

aster, canna, chrysanthemum, cosmos, dahlia, rose, daisy, sweet pea, and zinnia. It hibernates in the adult stage. The eggs are laid under the surface of the soil in the spring and the larvæ hatch from them after a brief period, feed for about a month, and then change to the resting or pupal stage in the ground, which lasts for about a week.

A closely related species, the western spotted cucumber beetle[53] (fig. 44), attacks daisy, rose, zinnia, and chrysanthemum.

Arsenate of lead as used for the general leaf feeders is the most useful remedy. Bordeaux mixture added to the lead arsenate serves as a repellent.

FIG. 42.—Rose chafer, or "rose bug": Beetles attacking chestnut blossoms. (Quaintance and Siegler)

BLISTER BEETLES

Many garden flowering plants, particularly aster, phlox, and gladiolus, are attacked by blister beetles, especially the black blister beetle[54] (fig. 45). These beetles frequently occur in enormous numbers and ruin the plants infested. They usually appear after about the middle of June and

[52] *Diabrotica duodecimpunctata* Fab.
[53] *Diabrotica soror* Leconte.

[54] *Epicauta pennsylvanica* De G.

their injury is accomplished in the adult stage. Figure 46 shows the margined blister beetle and injury caused by it.

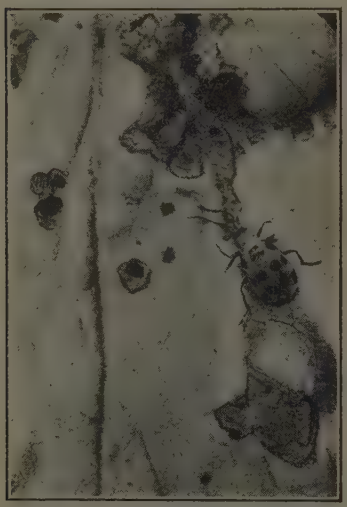


FIG. 43.—The 12-spotted cucumber beetle feeding on aster

Thorough spraying or dusting of the infested plants with an arsenical as soon as the beetles appear is recommended, although bagging or protecting with cheesecloth or mosquito bar may be resorted to for choice plants. According to H. F. Dietz, spraying the plants with nicotine oleate (see pp. 4–5), a contact insecticide, 1 fluid ounce to 1 gallon of water, has proved successful in Indiana.

FIG. 44.—The western spotted cucumber beetle

FLEA BEETLES

Flea beetles frequently are found feeding on and skeletonizing the foliage of garden flowering plants. They

FIG. 45.—Adult of the black blister beetle. (Weigel and Sasscer)

are small, usually metallic colored beetles and are very active. The potato flea beetle[56] feeds on the leaves and flowers of petunia (fig. 47).

The striped flea beetle[58] and the western garden flea beetle,[57] although

FIG. 46.—The margined blister beetle and its injury

better known as pests of the truck garden, are also found attacking stock, wallflower (fig. 48), and alpine rock cress. There are several generations a year.

Thoroughly spray or dust with arsenate of lead, especially when the

[55] *Epitrix cucumeris* Harris.
[56] *Phyllotreta vittata* Fab.
[57] *Phyllotreta pusilla* Horn.

beetles are first observed in the spring. Thorough spraying with Bordeaux mixture will repel them.

The primrose flea beetle [58] is metallic blue in color and is rather abundant in both the adult and the larval stages on evening primrose. The first generation of beetles appears in early June. The second generation usually appears in late July, lays its eggs, and the adults from these overwinter either unemerged in their cells or in some other protected location.

FIG. 47.—Feeding holes on leaf of petunia caused by the potato flea beetle

FIG. 48.—Adult striped flea beetle and their work on leaf of wallflower

[58] *Haltica marevagans* Horn.

The same control measures are recommended as for the striped and the western garden flea beetles.

LEAF BEETLES

Certain other beetles are found occasionally on flowers. Of these the rose

FIG. 49.—A tortoise beetle and its injury on leaf of Chinese lantern

leaf beetle[59] attacks the rose, and the plum leaf beetle[60] attacks the dahlia. Spray or dust with arsenate of lead or Paris green.

FIG. 50.—The rose curculio. (Chittenden)

THE GOLDEN TORTOISE BEETLE

The golden tortoise beetle or "goldbug"[61] eats holes in the leaves of morning-glory during the day, and another species[62] injures the leaves of Chineses lantern plant (fig. 49).

Handpick and destroy. Spray or dust with arsenate of lead or pyrethrum.

[59] *Nodonota puncticollis* Say.
[60] *Nodonota tristis* Oliv.
[61] *Metriona bicolor* Fab.

THE ROSE CURCULIO[63]

The rose curculio is a bright red snout beetle (fig. 50) with black legs and snout, only one-fourth of an inch long, and is distributed widely throughout the United States. In the Northern States the curculios appear on rose bushes and peonies early in June and disappear in August. The beetles inflict their injury by boring holes with their beaks into the unopened buds, leaves, fruit, and flower stems. As a result many of the injured buds fail to open, and those that

FIG. 51.—Fuller's rose beetle. (Weigel and Sasscer)

do expand are riddled with holes. The eggs are laid in the buds and young fruits and hatch in a week or 10 days, producing white legless grubs which feed on the seeds until full-grown. Afterwards they enter the ground, change to pupæ, and hibernate. This species has but a single generation annually.

Shaking the beetles into shallow pans containing kerosene has proved a practical and effective means of control. In case of heavy infestation, spray with arsenate of lead. The destruction of wild roses growing in the vicinity of the garden is beneficial. Cultivation in late fall or early spring kills the insect in the soil. Collect

[62] *Deloyala clarata* Fab.
[63] *Rhynchites bicolor* Fab.

dried buds and burn them, since they contain larvæ.

THE ROSE WEEVIL

The rose weevil, also called "Fuller's rose beetle,"[64] is preeminently a greenhouse pest in some parts of the country, but it occasionally becomes a serious menace in the flower garden. The beetle (fig. 51) is only one-fourth to three-eighths of an inch long, dirty brown or gray, and has a whitish diagonal line on each wing cover. Both the larvæ and beetles are destructive and do most of their feeding by night, the former attacking the roots and the latter feeding on the foliage, buds, and flowers, and at times severing the leaves.

Among the plants on which it feeds are the following: Canna, azalea, rose, Washingtonia palm, camellia, dracaena, Cape jasmine, and achyranthes.

The rose weevil may be controlled by jarring the infested plants, causing the weevils to fall to the ground,

FIG. 52.—Larvæ of the black vine weevil. (Weigel and Sasscer)

where they may be collected and destroyed. Plants may be protected from the beetles by banding them with sticky material or other barriers. Trapping under boards placed beneath the plants during the daytime is recommended. Apply carbon disulfide as directed under "Ants."

THE BLACK VINE WEEVIL[65]

The black vine weevil (figs. 52 and 53), also known as the cyclamen weevil, feeds on cyclamen and several other garden plants. The grub and beetle closely resemble those of the rose weevil.

Same control as for the rose weevil.

THE EUROPEAN HORNET[66]

The European hornet (fig. 54) has become established in the eastern part

FIG. 53.—Black vine weevil. (Weigel and Sasscer)

of the United States and sometimes causes damage to flowering plants, particularly to lilac and dahlia (fig. 55), by peeling them.

FIG. 54.—European hornets. (Britton)

In combating this insect the best course to pursue is to locate the nest and destroy it. First plug the outlet carefully with a piece of cotton soaked in chloroform and then either burn the nest where it hangs with a torch or

[64] *Pantomorus fulleri* Horn.
[65] *Brachyrhinus sulcatus* Fab.
[66] *Vespa crabro* L.

flaming kerosene-soaked rag on a stick or else carefully remove and burn the insects. When working with wasps or similar stinging species one should be careful to wear heavy gloves and keep

FIG. 55.—Dahlia stem gnawed by hornets. (Britton)

veiled. It is safer and more effective to conduct such operations after dark, when practically all of the colony are in the nest and the wasps are not so active as in the daytime.

PITH-NESTING BEES AND WASPS

Borers attacking the pruned or broken ends of branches are usually nesting bees or wasps which find the soft pith a good place in which to build their nests (fig. 56). The leaf-cutter bee[67] is a good example of this group of insects. In addition to its nesting habit, it frequently attracts attention by the circular areas which it cuts from rose leaves. These pieces of leaves are used in forming a thimble-like cup or nest (fig. 57) in the stems of large-pithed plants such as dahlias.

The infested shoots should be removed and burned. Puttying or painting the ends of broken or pruned shoots and pushing tacks into the pith so that the heads cover the ends will prevent further injury.

GRASSHOPPERS

Not infrequently grasshoppers (fig. 58) and crickets become a problem in iris beds and in the flower garden, eating foliage, flowers, and tender growth.

When such conditions exist these insects may be combated by liberal applications of the poisoned bran mash described under "Cutworms," with the addition of the pulp and rind of lemons or oranges finely ground. Plowing, disking, or spading deeply in

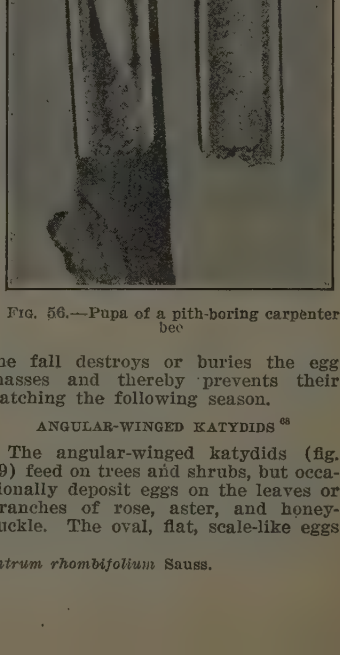


FIG. 56.—Pupa of a pith-boring carpenter bee

the fall destroys or buries the egg masses and thereby prevents their hatching the following season.

ANGULAR-WINGED KATYDIDS[68]

The angular-winged katydids (fig. 59) feed on trees and shrubs, but occasionally deposit eggs on the leaves or branches of rose, aster, and honeysuckle. The oval, flat, scale-like eggs

[67] *Megachile* sp.

[68] *Microcentrum retinerve* Burm. and *Microcentrum rhombifolium* Sauss.

FIG. 57.—Larva of leaf-cutter bee in rolled leaves inside dahlia stalk

FIG. 58.—Grasshopper on stalk of sunflower. (Milliken)

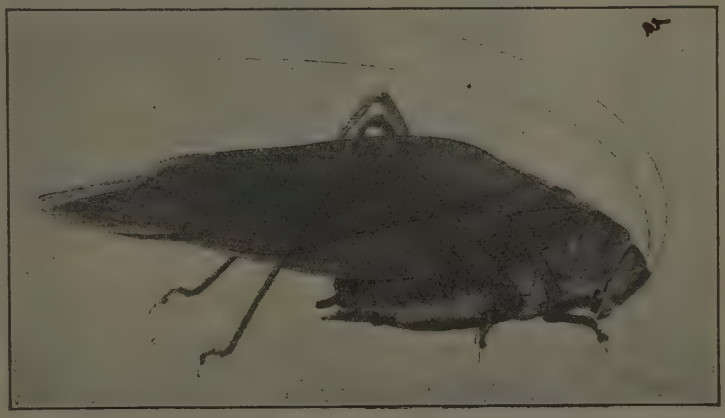


FIG. 59.—Adult angular-winged katydid. (Horton and Pemberton)

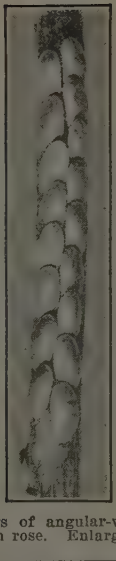


FIG. 60.—Eggs of angular-winged katydid on rose. Enlarged

(fig. 60) are placed in neat rows on leaves or twigs so that they overlap and are easily recognized.

Remove and destroy portions of the plant bearing the eggs.

TREE CRICKETS [69]

Tree crickets derive their name from the fact that they inhabit trees, although shrubbery and other plants are not immune from their attacks. Considerable injury results from their egg-laying punctures, which cause the death of the twigs, especially the portions beyond the point of attack. The body of the tree cricket is about one-half inch long, light green or light brown, and rather slender (fig. 61). The punctures are made in rows on the twigs during late summer and the eggs hatch the following spring.

Remove and burn such twigs in early spring or in the course of winter pruning.

LEAF MINERS

THE ARBORVITÆ LEAF MINER [70]

The arborvitæ leaf miner is a small moth which appears usually in June.

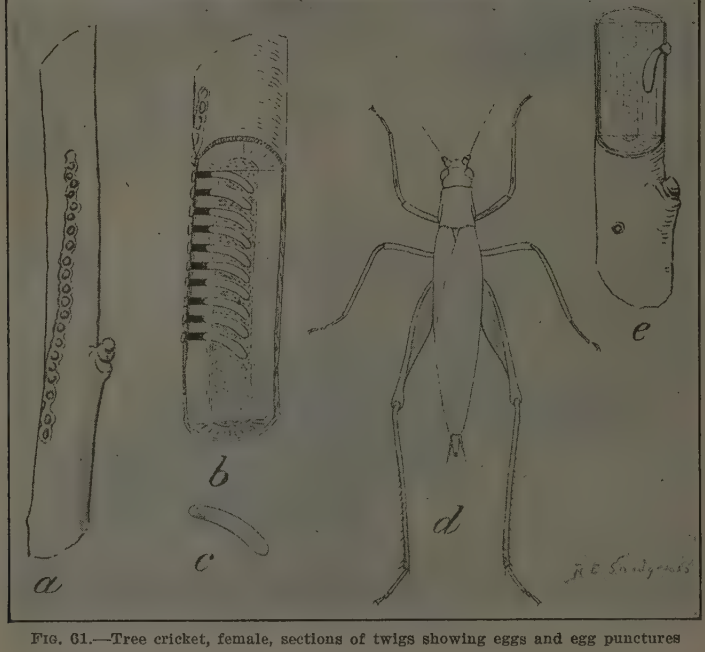


FIG. 61.—Tree cricket, female, sections of twigs showing eggs and egg punctures

[69] *Oecanthus* spp., usually *O. nigricornis* Walk. [70] *Argyresthia thuiella* Pack.

It lays its eggs on the leaves of the arborvitæ, and the young larvæ on hatching bore into the leaf tissue (fig. 62) and start their mines.

Cutting and burning the infested portions is the best remedy. This should be done in the fall or early spring before April 1, so that no chances are taken on the possible early issuance of some moths. Spray the arborvitæ thoroughly as often as necessary in late May, June, and early July with arsenate of lead. Nicotine sulphate with soap is effective against the young larvæ which hatch from eggs laid by females that have escaped the cutting and burning. This mixture is also effective when used

FIG. 62.—Arborvitæ leaves showing tips injured by leaf miner

during the period of flight of the moths.

In the control of certain other leaf miners such as the marguerite fly, considerable success has attended the use of a nicotine-sulphate and soap solution sprayed on the leaves about the time the first mines show.

[71] *Monarthropalpus buxi* Laboul.

THE BOXWOOD LEAF MINER[71]

The boxwood leaf miner is a small fly, the larva of which feeds within the leaf of the boxwood. The larva produces a yellowish, rather oval blotch (fig. 63) on the upper side of

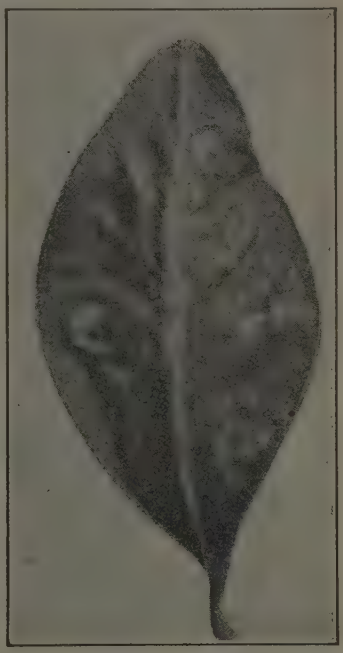


FIG. 63.—Injury by boxwood leaf miner

the leaf and a yellowish swollen under side. These mines discolor and kill the leaves and result in the disfigurement and ruin of the bush. The larva is light orange and spends its whole life within the leaf, the adults emerging, flying, mating, and laying eggs during a short period in May and June.

Where bushes are badly infested the injured portions should be removed and destroyed by burning. Spray with nicotine-sulphate solution described under "Contact insecticides" to which 1 part (or quart) of molasses should be added for every 3 parts (or quarts) of water. Spraying should commence when the adults first begin to emerge, usually early in May, and should continue at intervals of from five to seven days as long as adults are flying.

THE COLUMBINE LEAF MINER[72]

The columbine leaf miner during the larval period feeds in the leaves of columbine (fig. 64) and aster, leaving a white serpentine trail or mine visible on the upper surface of the leaves. The mine frequently crosses itself and ends in a spot one-eighth of an inch wide. The small, dark-brownish flies emerge in May, feed, and deposit eggs in the underside of the leaf. The larva hatches, feeds for about 10 days, and then pupates on the leaf. Eight or ten larvæ may develop in a single leaf. The last generation appears about the middle of September and passes the winter as a pupa in the soil.

FIG. 64.—*a*, Work of the columbine leaf miner; *b*, trail of a serpentine leaf miner

Spade the ground about the plants in March before the flies emerge. Also remove and destroy the infested leaves whenever present during the summer.

INSECTS THAT SUCK PLANT JUICES

Many insects and other pests of the flower garden feed by sucking juices from the soft succulent growth, tender leaves, and flowers. Such a method of feeding prevents the use of an arsenical or stomach poison in controlling them because no part of the surface tissue of the plant is swallowed. Consequently to combat them successfully it is necessary to use contact insecticides as previously discussed.

APHIDS

Aphids are small, soft-bodied, pale whitish or greenish to blackish insects with pear-shaped or nearly globular bodies, and possess six rather long legs. As a rule they are without any protective covering. The aphids, often called "plant lice," usually are not responsible for the death of plants but sometimes reduce their vigor considerably, curl and distort the leaves, harden the buds, and otherwise cause malformation of the flowers. Plants infested with aphids are unattractive in appearance and are often visited by great numbers of ants and other insects that feed upon the honeydew excreted by the aphids. Honeydew is a sweet, sticky liquid that gives a varnishlike or sooty appearance to leaves of infested trees and objects beneath them. Aphids move about somewhat, but are usually found in considerable clusters on new growths at the base of buds and on the under sides of leaves. They seem to be sensitive to weather conditions and are preyed upon by many natural enemies.

Among the aphids usually found in flower gardens the following are the

[72] *Phytomyza aquilegiae* Hardy.

most common: The rose aphid,[73] the small green rose aphid,[74] the black chrysanthemum aphid,[75] the green chrysanthemum aphid [76] (fig. 65), the green peach aphid,[77] and the bean, or nasturtium, aphid [78] (fig. 66).

Frequently it becomes necessary to combat aphids by thorough and forcible spraying with a nicotine sulphate or a soap solution.

ROOT APHIDS [79]

Certain species of plant lice attack the roots of asters and a number of varieties of plants, frequently causing extensive injury to those infested. In case of asters, for example, after an attack by aphids little or no growth is made, and the leaves soon turn yellow and wilt in the bright sun. Upon examing the roots, small, bluish-green aphids are usually found. These pests are fostered by several species of

FIG. 65.—Green chrysanthemum aphids

garden ants, which place the plant lice upon stems of desirable plants and care for the eggs during the winter, later transferring the young lice to the roots along which they have made burrows.

Use carbon disulphide as described under "Ants." Fresh tobacco dust mixed with equal parts of air-slaked lime should be thoroughly worked in around the roots of infested plants, or if larger areas are concerned, the surface should be treated with a heavy coating of this mixture which should be worked in by thoroughly spading

FIG. 66.—Bean aphids on nasturtium stem

over the entire area. This should be done sufficiently in advance of the replanting to permit the rains to leach these materials through the soil, where the chemicals will operate against the insects.

When an aster field is known to be infested with this form of aphid, it is advisable to rotate the crops, using the ground for plants not closely related to aster. Thorough plowing in late fall will destroy the ant nests, where the aphid eggs are then found, by exposure to the weather.

THRIPS

Frequently flowers become infested by extremely minute insects, the feeding work of which causes browning of the petals, and the flowers sometimes fail to open normally. These insects are usually yellowish to brown or blackish in color, considerably longer than broad, and flattened. They move rapidly and are rarely seen, usually retreating into the crevices between the bases of the petals. Because they are chiefly flower infesting,

[73] *Macrosiphum rosae* L.
[74] *Myzaphis rosarum* Kalt.
[75] *Macrosiphoniella sanborni* Gill.
[76] *Rhopalosiphum rufomaculata* Wils.
[77] *Myzus persicae* Sulz.
[78] *Aphis rumicis* L.
[79] *Aphis maidiradicis* Forbes and *Trama erigeronensis* Thomas.

it is rather difficult to prevent injury to the flower when the insects are present and at the same time to preserve its beauty.

The onion thrips,[80] the greenhouse thrips,[81] the flower thrips[82] and the Florida flower thrips[83] (fig. 67) are the species most frequently encountered.

FIG. 67.—The Florida flower thrips. (Watson)

Spray with nicotine sulphate and soap solution. Injury may be prevented by carefully disposing of old or badly infested blooms, rubbish, and weeds.

GREENHOUSE WHITE FLY[84]

The greenhouse white fly (fig. 68) attacks flowering plants out of doors,

FIG. 68.—Greenhouse white fly, male and female. (Quaintance and Baker)

including calendula, lantana, goldenglow, coleus, aster, and columbine, especially when grown near greenhouses or conservatories. The four-winged white flies are about one-sixteenth of an inch long, and suck the juices of the plant, causing it to turn yellow and die. The small, light green, scalelike larvæ feed on the leaves and excrete a honeydew, which gives the foliage a glazed appearance.

Spray thoroughly with nicotine sulphate and soap, fish-oil soap solution, or nicotine oleate.

SCALE INSECTS

Scale insects which attack plants in the flower garden vary considerably in appearance. They may be circular, oval, elliptical to oyster-shell-shaped, and even linear and somewhat rectangular. Some are flattened and others elevated so that when oval in outline they resemble a tortoise shell in shape. In color they range from

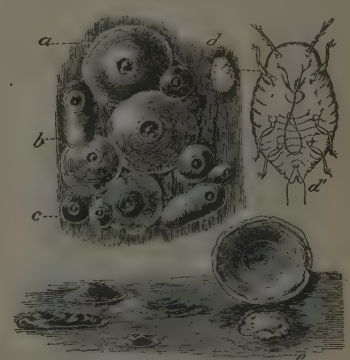


FIG. 69.—The San Jose scale: *a*, Adult female scale; *b*, male scale; *c*, young scales; *d*, larva just hatched; *a'*, same highly magnified; *e*, scale removed showing body of female beneath. All much enlarged. (Quaintance)

white to blackish, with grays and browns predominating. They are usually present in great numbers and adhere closely in patches to the portion of the plant infested. They move about only when just hatched from the egg or escaping from the parent female and soon locate a favorable spot in which they settle, introduce their beaks, feed, become motionless, and develop a waxy covering. These insects produce a serious and almost constant drain upon the plants attacked. They seem less affected by variations in weather or natural enemies than the aphids, and owing to their protective covering are difficult to combat.

Remove and burn dead, dying, and badly infested plants. In addition,

[80] *Thrips tabaci* Lind.
[81] *Heliothrips haemorrhoidalis* Bouché.
[82] *Frankliniella tritici* Fitch.
[83] *Frankliniella tritici bispinosa* Morg.
[84] *Trialeurodes vaporariorum* Westw.

thorough spraying of the remaining plants with the solution recommended in the following pages under the particular species of scale insect may be of considerable value.

THE SAN JOSE SCALE[85]

The San Jose scale is an extremely injurious fruit-tree scale which sometimes invades the gardens, attacking mountain ash, lilac, snowberry, dogwood, flowering peach, apple, rose, and many other hosts. It is a rather flat, grayish, circular scale (fig. 69), about the size of a pinhead and with a central nipple.

FIG. 70.—The oyster-shell scale on poplar. Much enlarged. (Quaintance and Sasscer)

Remove and burn all dead and heavily infested material. Thoroughly spray infested plants with lime-sulphur in the fall after the leaves drop and again in the spring before they appear. After the infestation has been considerably reduced, one spraying in the spring will be sufficient. Since lime-sulphur solution may soil paint, brick, or cement work, lubricating-oil emulsion (1 part to 33 parts, see "Contact insecticides") may be substituted.

THE OYSTER-SHELL SCALE[86]

The oyster-shell scale may be recognized because of its resemblance to a miniature oyster shell (fig. 70).

To control this insect, spray while plants are dormant with a 10 per cent solution of kerosene emulsion, or with

FIG. 71.—The scurfy scale. Enlarged. (Quaintance and Siegler)

lime-sulphur during late fall or early spring. It may also be combated by summer-strength applications of these same insecticides when the young scales hatch in the spring.

H. F. Dietz, in correspondence with the writers, has recommended the following spray as effective if applied from the last week in May to June 15. It kills the very young scales.

1 pound of fish-oil soap.
1 fluid ounce of 40 per cent nicotine sulphate.
4 gallons of water.

THE SCURFY SCALE[87]

The females of the scurfy scale (fig. 71) are somewhat flat, pear shaped, a dirty gray in color, and about one-eighth of an inch in length. They derive their name from the grayish

[85] *Aspidiotus perniciosus* Comst. [86] *Lepidosaphes ulmi* L. [87] *Chionaspis furfura* Fitch.

scurfy appearance which they give to infested bark. The male is smaller, whitish, and threadlike in appearance. The life history of the scurfy scale is similar to that of the oyster-shell scale. Lilac, mountain ash, and many other plants are attacked by it.

Same control as for the San Jose scale.

THE EVONYMUS SCALE[88]

The evonymus scale somewhat resembles the scurfy scale, but the

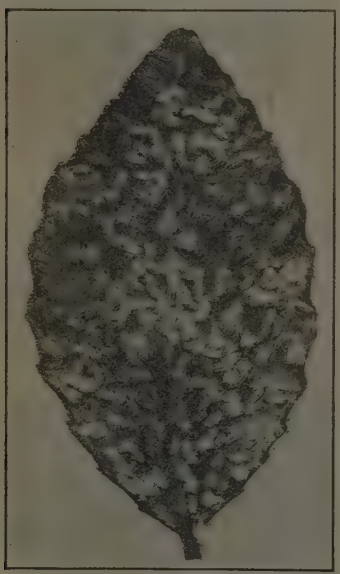


FIG. 72.—Leaf infested with the evonymus scale

females are smaller, elongate-oval, and brown. In heavy infestations (fig. 72) the males cause the plants to appear as if covered with frost. Two broods occur annually and the insect overwinters in the female and egg stages. The eggs hatch from the last of May to early June. Both deciduous and evergreen species of evonymus are attacked.

Spray several times during the winter with the fish-oil soap solution, the 10 per cent kerosene emulsion, or the lubricating-oil emulsion (1 part to 33 parts, see "Contact insecticides").

THE ROSE SCALE[89]

Not infrequently rose bushes are found completely incrusted with a snow-white substance. On close examination this material proves to be small scalelike bodies thickly massed or clustered on the twigs (fig. 73).

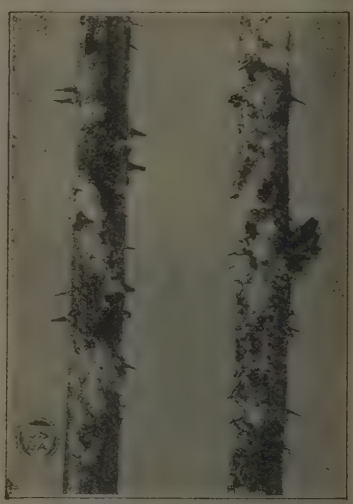


FIG. 73.—Twigs infested with the rose scale. (Weigel and Sasscer)

The female scales are nearly circular; the males are much smaller, long and narrow.

Same control as for the San Jose scale.

FIG. 74.—Short-tailed mealybugs on under surface of leaf

MEALYBUGS

Somewhat closely related to the armored scale insects described above is a group of soft-bodied sucking insects called mealybugs, which includes

[88] *Chionaspis euonymi* Comst.

[89] *Aulacaspis rosae* Bouché.

the short-tailed mealybug[90] (fig. 74) and the long-tailed mealybug.[91] These derive their name from the fact that instead of a scale they are protected by a white, waxy, or mealy secretion that coats their bodies. This secretion is peculiarly protective against spray materials.

In combating mealybugs with sprays it is essential that the spray be applied forcibly. Sprays such as nicotine sulphate, soap, and water, or frequent and forcible syringing or spraying with plain water, will usually be found effective. As in the case of scale insects, dead, dying, and heavily infested, or less valuable plants that can be spared should be removed and

FIG. 75.—Portion of coleus plant infested with the greenhouse Orthezia. (Weigel and Sasscer)

destroyed by burning. On hardier plants either a 5 per cent solution of kerosene emulsion, or the nicotine-fish oil soap solution which is recommended for the oyster-shell scale is a satisfactory remedy to apply.

THE GREENHOUSE ORTHEZIA

The greenhouse Orthezia[92] is a scale insect which also feeds on many varieties of bedding plants out of doors. Lantana, chrysanthemum, coleus, heliotrope, periwinkle, petunia, and salvia are particularly subject to injury. The mature female (fig. 75) is conspicuous because of its waxy marginal fringe and long white fluted egg sac. All stages are active and settle in colonies on the leaves and stems of the plants. The constant sucking of the vital juices weakens the hosts, so that they become sickly and sometimes die.

Same control as for mealybugs.

FIG. 76.—Injury to terminal growth by tarnished plant bug. (Weigel and Sasscer)

PLANT BUGS

Sometimes plants are injured considerably by the feeding of plant bugs, which causes the death or malformation of the parts attacked. Frequently

FIG. 77.—The tarnished plant bug. (Weigel and Sasscer)

buds of flowers fed upon by these insects are "blasted" (fig. 76) and either die or fail to open normally. Many plant bugs are capable of flying and running with great rapidity,

[90] *Pseudococcus citri* Risso. [91] *Pseudococcus adonidum* L. [92] *Orthezia insignis* Dougl.

and they generally feed on a variety of host plants. These features greatly complicate the work of protecting the flowering plants from injury.

FIG. 78.—Work of the rhododendron lace bug

THE TARNISHED PLANT BUG [93]

The tarnished plant bug probably ranks as the chief offender, and inflicts much injury on a wide range of host plants, especially aster, dahlia, zinnia, marigold, saffron, and chrysanthemum. The full-grown bugs (fig. 77) are a little more than one-fourth of an inch long, varying in color but usually a brassy brown marked with yellowish and black dashes.

The most important practice in controlling these pests is clean culture in and around the flower garden. All weeds and all trash which may serve as hibernating quarters should be gathered and burned. Spraying in the early morning with the nicotine-sulphate solution is effective against the young or nymphs. Because of their great activity, spraying for the adults is of no value. Adults may be collected in the early morning by beating them into a pan containing water covered with a film of kerosene.

FIG. 79.—An adult chrysanthemum lace bug. Greatly enlarged. (Wade)

THE FOUR-LINED PLANT BUG [94]

The four-lined plant bug renders the foliage of many shrubs and plants, including aster, dahlia, and zinnia, unsightly. It is a bright greenish-yellow, one-fourth of an inch long, with two black spots on the thorax and four stripes of the same color down the back.

Same control as for the tarnished plant bug, and, in addition, clipping and burning such shoots as contain the eggs. Dusting with pyrethrum is recommended

PHLOX BUG [95]

Phlox plants often suffer from the attacks of another closely related species called the phlox bug. It is not

[93] *Lygus pratensis* L.
[94] *Poecilocapsus lineatus* Fab.
[95] *Lopidea media* Say.

over one-fourth of an inch long, is very active, and may be recognized easily by the dull orange or reddish wing margins and black stripe on the back.

Same control as for the tarnished plant bug.

THE RHODODENDRON LACE BUG [96]

The leaves of the mountain laurel and rhododendron are sometimes found pale and unhealthy in appearance (fig. 78), the under sides spotted with a dark resinous material. These spots are the droppings of the lace bugs. This species overwinters in the egg stage. The eggs, which are nearly cylindrical, are usually deposited in

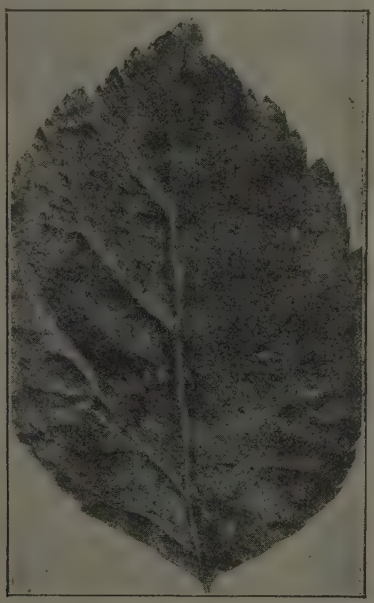


FIG. 80.—Leaf showing mottled appearance caused by the rose leafhopper. (Quaintance and Siegler)

pockets on the lower surface of the midrib of the leaf. The young hatch in May and the adults appear about one month later. There seem to be two broods annually.

Spray the under surface of leaves when insects are present, especially when nymphs first appear in the spring, with either of the following insecticides: Fish-oil soap and nicotine-sulphate solution, or a 5 per cent solution of kerosene emulsion.

THE AZALEA LACE BUG [97]

The azalea lace bug, which occurs on azaleas, is related to the rhododendron lace bug, and although apparently often producing three generations annually, is still sufficiently like the latter not to need separate treatment. Another species, the chrysanthemum lace bug [98] (fig 79), feeds on this host.

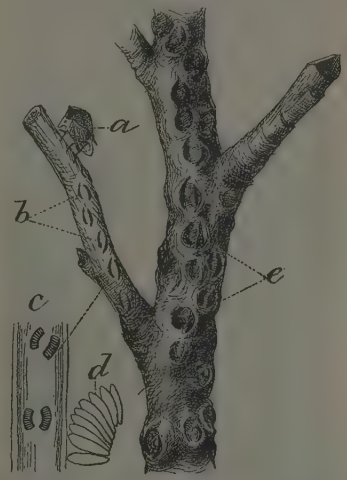


FIG. 81.—Twig showing work of buffalo treehopper: *a*, Female at work; *b*, recent egg punctures; *c*, bark reversed with eggs in position, slightly enlarged; *d*, single row of eggs still more enlarged; *e*, wounds of two or three years' standing on older limbs. (Marlatt)

Same control as for rhododendron lace bug.

THE ROSE LEAFHOPPER [99]

The rose leafhopper is narrow, yellowish white, and active and its presence is usually indicated by a fading of the leaves (fig. 80). The species overwinters in the egg stage. The eggs are deposited by the adults under the bark of the plant, and the whitish nymphs hatch from them about the beginning of May. The nymphs feed by sucking juices from the leaves, causing them to lose their color.

Thorough spraying of the leaves, when the young are present, with a nicotine-sulphate and soap solution applied in such a manner as to bring the

[96] *Leptobyrsa rhododendri* Horv.
[97] *Stephanitis pyrioides* Scott.
[98] *Corythucha marmorata* Uhler.
[99] *Empoa rosae* L.

material in contact with the bodies of the young leafhoppers usually is effective.

THE BUFFALO TREEHOPPER [1]

The buffalo treehopper (fig. 81) is an active, grass-green, triangular insect having a characteristic two-horned enlargement at the front, and is about three-eighths of an inch long. Although eggs are frequently deposited in slits in the bark of trees or in nursery stock, especially rose, the nymphs which hatch from them the following spring feed on asters, other annual plants, and weeds.

Clean culture about the garden and destruction of weeds by burning are

FIG. 82.—Arborvitæ injured by spider mites

of vital importance. If fresh egg scars are found on twigs, they should be cut out and burned before they hatch in the spring.

THE BLACK STINKBUG [2]

The black stinkbug is another of the plant-feeding bugs which attack flowers. It stunts bud clusters, deforming individual buds, and is found on snapdragon and columbine.

Same control as for the tarnished plant bug.

THE SPITTLE BUGS [3]

The spittle bugs, although not often sufficiently injurious or numerous to do much damage, are sometimes of economic importance, occasioning losses to chrysanthemum and other plants. Their name is derived from the peculiar "frothy" material with which the nymphs cover themselves. They have a number of local names, such as "frog-spit" and "snake-spit."

Spray with nicotine sulphate and soap solution, if necessary. Burn over the infested areas during the late winter or early spring.

MISCELLANEOUS AND SOIL PESTS

SPIDER MITES

Among the most minute, persistent, and general of plant-feeding animals possessing jointed appendages are the spider mites, especially the red spider.[4] These small animals are relatives of the spiders and are similar to them in general characters but are sufficiently like insects to be considered here advantageously. Spider mites feed by sucking juices from the leaves and other portions of plant tissue (fig. 82) and attack an extremely wide range

FIG. 83.—Galls on rose produced by gall makers (*Rhodites multispinosus*).

of plants. Attack by spider mites causes paling and browning of foliage, which on close examination is found to be composed of minute pale and brown areas of feeding. Sometimes the leaves or infested parts of the plant are webbed, although often no webbing is visible. Although the spider mites themselves are not always found on specimens of injured plants examined, their pale-whitish shed skins, or near-

[1] *Ceresa bubalus* Fab.
[2] *Cosmopepla bimaculata* Thos.
[3] Cercopidæ.
[4] *Tetranychus telarius* L.

ly globular eggs or eggshells, are usually present and are sufficient to identify the cause of the poor health of the plants.

Cleaning up the garden is the first step to be practiced, gathering all litter, old leaves, weeds, and dead, dying, or heavily infested plants and burning them.

Spraying with nicotine sulphate, nicotine oleate, or soap solutions, or dusting with dry superfine sulphur, is recommended. Several applications of the insecticide selected are usually necessary and these should be made with an interval of a week or 10 days intervening between treatments. Frequent washing or syringing with a forcible stream of water under pressure directed on the plants from several angles is also of considerable value, but should not be used during the period in which any of the insecticides are being applied.

GALL MAKERS

Roses and some other flowering plants are subject to infestation by gall insects and mites. There are a number of these gall-producing animals belonging to various orders, chief among which are the four-winged gall flies or cynipids, the two-winged gall flies or cecidomyiids, the gall lice, aphids, and the gall mites. The swellings (fig. 83) produced by them are seldom a serious menace to the life of the plant, although they may kill the part attacked.

Cut off and burn the infested portions before the makers within can complete their development and emerge.

ANTS

Ants are frequently injurious or annoying in flower gardens. Sometimes they damage plants by nesting in them, and by their galleries opening up passages of decay into the interior of the sound parts, causing the death of the plant. Sometimes they are injurious through colonizing and protecting aphids. Often, however, they are merely annoying, attracted to plants by the presence of aphids or other sucking insects (fig. 84) which are excreting quantities of honeydew, a liquid much sought after by ants and other insects as food. Ants are also attracted by souring sap from wounds, and by sweet secretions of certain parts of plants, such as the flower buds of peonies.

When honeydew is responsible for the presence of ants, the insects supplying this material should be combated, and where wounds or hollows are the attraction infested plants should be destroyed or the wounds cleaned and protected by a thick coating of white lead paint or grafting wax. Spraying the infested spots with a nicotine-sulphate and soap solution or a 5 per cent solution of kerosene emulsion is of considerable value.

FIG. 84.—Ants attending a group of mealybugs. Their almost constant presence protects the mealybug from its natural enemies. (Woglum and Borden)

In combating ants the first step is to locate their nests. Holes should be made in the vicinity of the plant about a foot apart and not closer than 8 inches from the base of the plant, a little carbon disulphide poured into each, the holes closed, and the ground around covered for several days with some gas-proof material such as paper weighted with stones, or the surface of the soil kept moist by occasional sprinklings. As carbon disulphide vapor is inflammable and explosive when mixed with air in certain proportions,

and is poisonous, the liquid should be handled with care and not exposed near fire in any form, and the fumes should not be inhaled. Carbon disulphide can be purchased at most drug stores.

Poisoned-sirup baits are also effective, especially in combating the garden or cornfield ant. The following mixture is recommended: Make a sirup by boiling together 4 ounces of sugar and 2½ pints of water, after which add 11.3 grams of tartar emetic. Another effective bait is prepared by dissolving one-half pound of sugar in a pint of water and adding 62.5 grains of arsenate of soda. This mixture should be boiled and strained. Small pieces of sponge should be saturated with the poisoned sirup and distributed about the infested places with a

FIG. 85.—A white grub, the larva of a May beetle

shelter placed over them, or a small quantity of the sirup should be put in a shallow dish, so that the ants may easily reach it. If pieces of sponge are placed in the dish so that they come in contact with the sides, the ants will find easier access to the poison. Since tartar emetic and the other chemical ingredients are poisonous, *children and domestic animals must not be allowed access to them.*[5]

The Argentine ant, which occurs only in some of the Southern States and in certain parts of California, is best controlled by the so-called Government formula, prepared as follows: Dissolve 1 pound of granulated sugar in one-half pint of water and add 1.4 grams of tartaric acid (crystallized). Boil these ingredients slowly for 30 minutes and allow to cool. Then dissolve 1.4 grams of sodium arsenite in one-half ounce of hot water and allow to cool. Combine the two solutions by thorough stirring. Finally, add 1½

FIG. 86.—Wireworm injury to roots and stalk of young aster plants

ounces of honey. Use on small pieces of sponge as previously described.

WHITE GRUBS [6]

White grubs (fig. 85), the immature forms of May beetles or "June bugs," and similar larvæ of beetles [7] living in the soil are somewhat injurious to

[5] It is recommended that the chemical ingredients be purchased from a druggist and only in such quantities as are specified in the formulas.

[6] *Phyllophaga* spp.

[7] The green June beetle, *Cotinis nitida* L.; Japanese beetle, *Popillia japonica* Newm.; the leaf chafers, *Anomala* spp.

garden flowering plants such as iris, gladiolus, dahlia, rose, violet, geranium, hyacinth, and privet, and also to lawns and golf courses. The larvæ may feed upon the roots of plants, or the adults, during their flight period, may eat the leaves, causing defoliation.

When the infestation is heavy enough to warrant the treatment, use carbon disulphide as recommended under "Ants." Recently a carbon-disulphide emulsion has been developed which is effective for controlling white grubs. Prepare as follows:

	Parts by volume
Rosin fish-oil soap	1
Water	3
Carbon disulphide	10

Place the soap and water in a wooden churn or a discarded ice-cream freezer and turn the handle for a few minutes in order to obtain an even mixture. Add the carbon disulphide and turn the handle for two minutes, or until the mixture becomes creamlike and thoroughly emulsified. Add 1 quart of this mixture to 50 gallons of water, and apply to the infested lawn at the rate of 3 pints to the square foot of surface.

For small areas this liquid may be applied with an ordinary sprinkling can, but great care should be taken not to apply more than one layer, for otherwise severe burning will almost surely result. Turning the soil in the late fall, or carefully working it in the spring, and killing such grubs as are found, or permitting chickens to run in the garden until seeding time, are all useful in combating these species.

WIREWORMS

Wireworms, as the name implies, are insects which in the larval stage have wiry, shiny, smooth, and cylindrical bodies. They are about 1 inch in length. In color they range from pale yellow to brown. They feed on the roots of pansies, asters (fig. 86), and other plants, and usually require more than one season for development. When full grown they are about one-half inch long, brown to black, very active, and are called "click" beetles because of the clicking noise which they make when they jump to right themselves when on their backs or when they are held between the fingers.

When the wireworms are present in injurious numbers the ground should be thoroughly worked, preferably in the late spring or early summer, and all larvæ encountered should be collected and killed. In case of extremely heavy persistent infestations a new piece of ground should be selected for planting.

MILLIPEDS OR "THOUSAND-LEGS"

Millipeds, called "thousand-legs" because they have many legs, are not true insects, which never have more than six. They are brown or grayish, hard-shelled, wormlike creatures, which, when disturbed, crawl rapidly

FIG. 87.—Roots of bleeding heart injured by millipeds

away. They live principally in the soil in such damp places as afford abundant decaying organic matter, such as manure. Millipeds attack only the roots and stems of plants (fig. 87).

Poisoned baits are an effective means of control. Sliced potatoes, apples, or turnips, rolled in dry Paris green or pyrethrum and placed about the infested beds, have proved efficient. Sprinkling the surface of the soil lightly with a dry mixture consisting of 9 parts of sugar and 1 part of dry Paris green is also effective.

Care, however, must be exercised to avoid getting any of the mixture on the foliage of the plants, for otherwise burning will result. Another remedy is to drench the soil with bichloride of mercury as recommended for earthworms.

SOWBUGS OR PILLBUGS

Sowbugs or pillbugs are about one-half inch long, dark gray, and oval. On being exposed to light most species are very active, although some forms roll themselves up into the shape of a round pill (fig. 88) upon the least disturbance, and from this action the name "pillbug" is derived. Their flattened bodies have about seven pairs of legs. They are not true insects. Their usual abode is under some shelter such as decayed

FIG. 88.—The greenhouse pillbug; Left, extended; right, contracted. Much enlarged. (Popenoe)

boards or flowerpots, in decayed manure, or in any other dark place where decomposition is in progress. They feed on the roots and tender portions of plants, especially the carnation and sweet pea.

Sprinkle the surface of the soil lightly with a dry mixture consisting of 9 parts of sugar and 1 part of Paris green, or with the poisoned-bran mash discussed under "Cutworms." A remedy similar to the former, which may be applied in the same manner, consists of 2 parts of white flour, 2 parts of sugar, and 1 part of Paris green. Dry tobacco dust is very effective as a repellent. The infested soil should be sprayed with a nicotine-sulphate and soap solution or a solution of kerosene emulsion. For prevention, hiding places should be destroyed by cleaning up and burning refuse.

TERMITES

Termites, or "white ants" (fig. 89), as they are usually called, sometimes attack geranium, heliotrope, and other

FIG. 89.—White ant, mature worker. (Weigel and Sasscer)

flowering plants and injure or kill them by eating out the stalk.

All infested logs, boards, and other woodwork in the vicinity of the garden

FIG. 90.—The spotted garden slug. (White)

should be removed and burned. When possible infested plants should be pulled up and destroyed by burning, since they have little chance for recovery when once attacked. In areas

which are badly infested with the termites carbon disulphide injected into their galleries as recommended under "Ants" will do much to eradicate them.

SLUGS AND SNAILS

Garden slugs[8] (fig. 90) and snails are sometimes injurious to flower gardens and are usually unwelcome guests.

All decayed boards, débris, bricks, and old flowerpots which serve as hiding places should be removed and air-slaked lime dusted liberally throughout the infested area. Moreover, a poisoned bait, such as boiled potato sprinkled with white arsenic or Paris green, should be distributed in this area.

In case of slugs collect the masses of translucent, yellowish eggs found in dark and damp locations and destroy them.

EARTHWORMS

Often the soil of pots and flower beds becomes overstocked with earthworms, and in some instances injury to the plants results. The worms are brought in with the soil or manure and breed very rapidly under favorable conditions. Their habit of tunneling through the fine root systems of the plants is often damaging and destructive to plant culture.

Bichloride of mercury or corrosive sublimate is a very good remedy. It is prepared by dissolving one-half ounce in 3 or 4 gallons of water. Apply to the infested soil. Since this chemical is a deadly poison it should be safeguarded in its preparation and handling. It corrodes metals, and should preferably be prepared in a glass or glazed vessel, which should be thoroughly cleaned immediately after use.

In recent tests with a saturated solution of lime water applied to the soil freely, a good control of earthworms resulted. About 2 cupfuls of unslaked lime placed in a 2-gallon bucket of water, thoroughly agitated and allowed to settle, will furnish the desired clear liquid. Tobacco dust thoroughly worked into the soil will prove effective also, and at the same time may have some value as a fertilizer.

[8] *Limax maximus* L.

INDEX

[The terms "abutilon insects," "ageratum insects," etc., in this index do not imply that the insects commonly attacking a given food plant are treated together under a food-plant heading; nor does it imply that all the insects commonly attacking a given food plant are mentioned in the bulletin in connection with that plant. So many of the insects treated are general feeders that a food-plant arrangement of the subject was impracticable and the food plants of these general feeders are not listed]

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